THE

ELECTRICAL REVIEW.

VOL. XLVI. APRIL 13, 1900. No. 1,168.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

Edition

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THE VERSATILE WAR CORRESPONDENT.

IN a leading article entitled "The Fourth Arm of the Service," published in our issue of March 9th last (Vol. xlvi., No. 1,163), we drew attention to some extraordinary statements made by Mr. Bennet Burleigh in the columns of the *Daily Telegraph* concerning the efficiency and value of the Royal Engineers in time of war. We alluded particularly to the lack of precise understanding displayed by our contemporary's war correspondent, and the very evil effect such ill-informed and misleading writing must have upon the British public. The attack on the Royal Engineers picked out for special stricture two sections of the corps, namely, the railway experts and the telegraphists. "As railway experts and telegraphists," says our critic, "they are neither as smart nor useful at the work as the trained specialists of civil life, who can always be obtained in time of war."

We wish to revert in greater detail to the particular sections of the Royal Engineers mentioned in this passage, with which we dealt only in general terms in our previous article.

We all expected to meet in our morning trains the aspiring generals who could have given admirable advice to Buller and conducted the Free State campaign with more skill and success than Roberts. Nor were we surprised that these experts spoke in such terms as to lead one to doubt whether they knew the difference between a company and a battalion, or which end of a gun was the muzzle. Such things we knew to be inevitable, and accepted them with philosophic calm. But we were hardly prepared to find that responsible papers should place men of seemingly non-technical qualifications upon their staff, whence they could, as "experts," address their thousands, or even millions, of readers upon subjects of great public import and interest. When these experts have won for themselves an honourable name in some other capacity, their influence becomes still more insidious and dangerous. Mr. Bennet Burleigh, whom we exempt from the above category, has an honourable record as a journalist and war correspondent, and has apparently presumed on his position so far as to make what seems to us an entirely unwarrantable attack on a valuable and loyal branch of our Army—an attack characterised by an apparent misconception of the real facts, and in which he exposes his want of accurate information at every turn.

In order to emphasise the valueless nature of the military telegraphists we have a comparison established with the "trained specialists of civil life." This is tantamount to an assertion that the "trained specialists of civil life" are efficient and valuable. The most extraordinary blunder is made here, for the military telegraphist and the trained specialist of civil life are one and the same person, the only difference being the uniform which even

Mr. Burleigh will not contend reduces the skill and efficiency of the man. We will prove this assertion by a brief account of the Telegraph Battalion of the Royal Engineers. In times of peace this battalion consists of two divisions, as follows:—The first division contains 173 non-commissioned officers and men, including drivers, &c. The latter are not, as a general rule, telegraphists. This division is stationed at Aldershot, and is trained specially in the duties of constructing, maintaining, and working the field lines. The second division is composed of 165 non-commissioned officers and men, of whom every one is employed in some capacity in the Southern Engineering District of the Post Office. About 60 of these men under normal conditions are employed in the larger post offices, such as Bristol, Exeter, Plymouth, Brighton, &c., as telegraph operators sharing the duties and conditions of the civilian operator. Speaking from personal experience, we can confidently aver that there is no distinction between them on the score of efficiency or smartness. The remainder of the second division carry on the engineering duties of the Southern postal district. Nor is it at all to be wondered at that they are of equal proficiency with their civilian colleagues, for it is safe to say that 75 per cent. of the second division are men who have left the Post Office employ to become telegraphists in the Corps of Royal Engineers, and even then have to pass a severe test. If reference is made to form $\frac{\text{P. } 98}{1,621}$, which gives the conditions of "enlistment of telegraphists in the Corps of Royal Engineers," it will be found that in addition to the usual physical conditions, the following qualification is demanded:—

"Proficiency as a telegraphist. To receive and send well on the Sounder not less than 22 words per minute, and to be able to take charge of a moderately busy sounder circuit in a Post Office."

Now, this is precisely the same test which is demanded of a postal telegraphist before he is given charge of a public wire. Evidently the expertness of a military telegraphist and that of the "trained specialist of civil life" are identical.

In times of war the Telegraph Battalion is reinforced by a Telegraph Reserve. The strength of this Telegraph Reserve before the present war was 100. It has now been raised to about 150, and will probably be still further increased. The men forming the Telegraph Reserve are postal operators who are also efficient volunteers. These men are among the pick of the "trained specialists of civil life," and are drawn from the Central Telegraph Office and other large postal centres. They are nominally enlisted into the Royal Engineers, serving one day with the colours, and are then passed directly into the reserve. They are men acquainted with all the latest developments of high-speed telegraphy, and thoroughly versed in the practical work of the profession. It is safe to say that 75 per cent. of the telegraphists employed on the lines of communication in South Africa at present are men of the Telegraph Reserve, and the whole of the Headquarters Staff of Telegraphists are such men. If efficient telegraphing can be done, if the lines are capable of high-speed work, the men now in South Africa who are actually the lauded "trained specialists of civil life" will be able to accomplish it. Fast Wheatstone sets are at work and rapid operators are in charge. So we see that the comparison made by Mr. Burleigh, which is intended to compare the military telegraphist unfavourably with his civilian brethren, is merely a splenetic display of journalistic zeal, which a knowledge of the real facts will not support. The military telegraphists of the Corps of Royal Engineers are practically the "trained specialists of civil life," who, for the nonce, have donned a uniform.

Exactly the same can be said of the railway companies of the corps. Those now employed in South Africa are largely made up of the Railway Reserve, which is almost entirely composed of the employés of the large railway companies, particularly the London and North-Western Railway Company.

Unfortunately for himself, Mr. Burleigh has chosen to attack the Royal Engineers at two points where their organisation and efficiency are greatest, and where their practical value and training are admitted to be of the highest order. In establishing a comparison, he has reduced his charges to mere absurdity, because the two terms of his comparison turn out on examination to be only one. We have endeavoured in this brief recital of facts to defend a valuable arm of our Service from unmerited attack, and to induce the tribunes of journalism to be more discreet in their utterances upon those matters which require a technical knowledge which is not usual among modern newspaper authors.

A recent issue of the *Times* contained the following from one of its correspondents. We quote it as a proof that opinions are divided among war correspondents themselves, as to the value of telegraph work being performed in South Africa:—

> The telegraph staff under Captain Godfrey Faussett has wrestled successfully with a heavy demand upon it. To set up an aerial line or trail an earth wire day after day in advance of headquarters and to keep it in efficient working order in spite of wilful interruptions, or, what is far commoner, the accidental breaks caused by wind, wandering animals, or even, as in a recent case, excessively stupid men, over a hundred miles of veldt, is a great achievement, and one for which thanks are due from correspondents more than from others, especially when they have invariably met with the utmost courtesy and consideration from all therewith connected.

It will be interesting to see whether the *Daily Telegraph* correspondent will adopt a more reasonable and kindly attitude towards the Royal Engineers when he has obtained a closer acquaintance with their work.

Electric Tramways and the Law of Nuisance.

We published in our last issue a report of the case of J. Goldberg & Sons *v.* the Corporation of Liverpool, which was heard in the Court of Appeal on April 3rd. A perusal of that case serves to show that although the tramway authority is much exposed to the risk of actions for nuisance, the power to execute all such works as may be "necessary or expedient" does confer upon the Corporation the right to interfere in some degree with the convenience of the public. It appears that the plaintiffs objected to the erection of a pole and fuse box outside their premises in Liverpool, and sought an order for their removal. This was granted by the Vice-Chancellor of the County Palatine at Lancaster, but the Court of Appeal reversed his decision on the following grounds: (1) That the Corporation in erecting the pole and the fuse box were acting within their statutory powers; (2) that they had exercised those powers *bonâ fide* for the purposes for which they were conferred. In the course of the argument the question arose as to whether the Corporation had any statutory power to commit a nuisance. The effect of the judgment delivered by the Master of the Rolls is that where the doing of any act or the erection of any work is authorised by Act of Parliament the mere doing of that act or the erection of that work is not a nuisance which the Court will restrain by injunction. "But for the Act," said his Lordship, "no doubt the plaintiffs could have maintained an action for nuisance. But the Act authorised a nuisance, and unless the plaintiffs can prove that the powers conferred by the Act have been abused, they have no remedy. . . . . The Court cannot go into the question as to what is the most convenient situation for a pole. If they did that they would have to lay down the tramway themselves." Seeing that the Corporation were in this case permitted to erect posts in such a manner as to occasion annoyance to dwellers by the wayside, it might be thought that all nuisances appurtenant to the supply of electricity will be allowed by law. Such, however, is not the case. It has been decided in many cases that leakage of electricity, vibration, or excessive smoke, are all nuisances in respect of which the public may claim the protection of the Courts, and this although the installation has been erected under so-called statutory powers. To borrow an instance from another class of erection, those who build a smallpox hospital, and who are subsequently sued by neighbours who object to the danger of infection arising therefrom, cannot plead that their right to build such a hospital involves permission to create a nuisance. Nevertheless, every work authorised by the Act can, upon the authority of the present case, be undertaken without risk of an action for nuisance, provided that negligence and *mala fides* are not proved against the defendants.

TRACTION MOTOR SUSPENSIONS.

By ERNEST KILBURN SCOTT, A.M.I.C.E.

Part I.—Motors with Gearing.

When a heavily-loaded tramcar passes an uneven joint in the rail, or meets with a slight obstacle, the wheels rise momentarily, and in falling again, produce a hammering effect on the rails and tyres. This, besides jolting the passengers, tends to reduce the life of the motors by abrading the insulation and breaking the commutator connections, whilst the extra stresses on the gearing and axles are also liable to give trouble by the metal becoming brittle. It was therefore soon seen that the proper suspension of the motors was a matter of supreme importance in electric traction, and that springs, or their equivalent, must be employed to avoid shock to the motor and gearing, as well as to allow a slight yielding of the motor at starting and stopping. Again, in order to ensure the teeth running smoothly, all geared traction motors must be hinged to the axle in some way, and yet, at the same time, so connected with the truck as to permit of slight movements of the motor relatively to the truck.

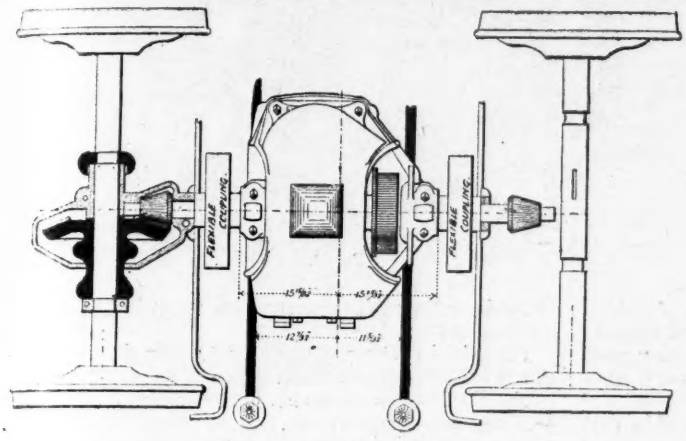


Fig. 1.

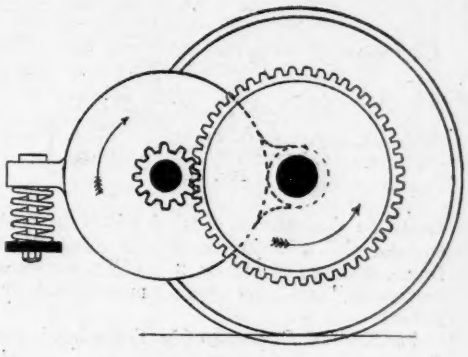


Fig. 2.

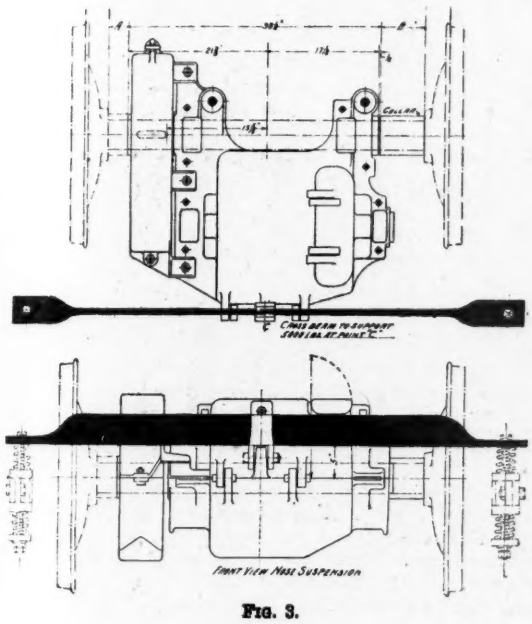


Fig. 3.

An early form of car truck had what may be called the *Sperry Suspension with bevel wheels* (fig. 1). A single motor was fixed parallel with the rails, bevel pinions being fitted at either end of the armature spindle and suitable bevel wheels keyed on the two axles.

The motor was supported from a cross piece fixed rigidly to the truck, the pinions being furnished with short spindles kept in alignment by pedestals swivelled on the main axles. In its normal position the motor spindle coincided with the pinion spindles, and slight displacements in the vertical plane were allowed for by flexible couplings at either end of the armature spindle. It will easily be seen that a worm-wheel drive could be arranged in a similar way.

Wheelbarrow Suspension.—The first motors which were employed with straight teeth gearing had two sets of wheels, and the motor was suspended "wheelbarrow" fashion. Fig. 2 shows the arrangement with single reduction gearing—one end of the motor rests on the axle, and the other end has a casting engaging with springs, which give slightly at starting and stopping, and so allow the motor to move through a small arc of a circle. It will be noticed that the frame enclosing the motor is subjected to an equal and opposite couple to the motor couple applied on the gear

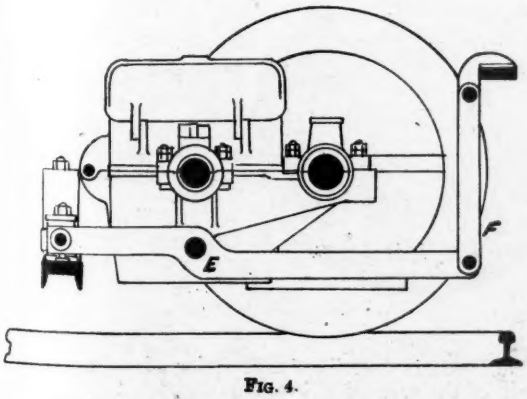


Fig. 4.

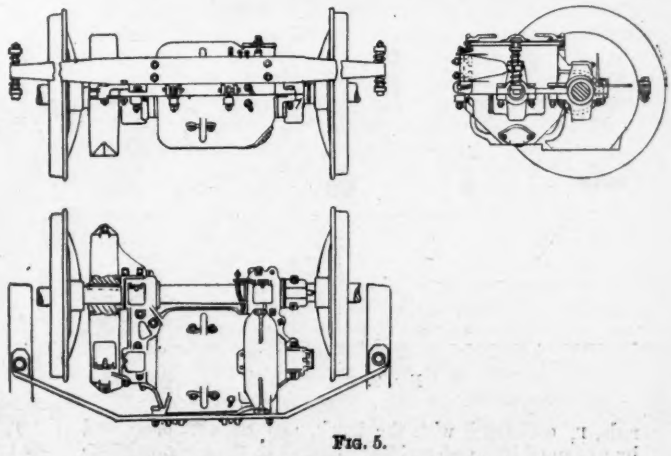


Fig. 5.

pinion, and that it tends in the case of transmission by single reduction to turn around the axle in the same direction as the motor, whilst with double reduction gearing the action is the reverse of this.

Nose Suspensions.—As there was not a good support for the springs in the centre of the truck, they were afterwards moved to the extreme ends of a bar, the centre of which engaged with a projection or nose cast on the field magnet frame, as shown at C in fig. 3. This is known as the "nose suspension," and it has been the most extensively used of any method.

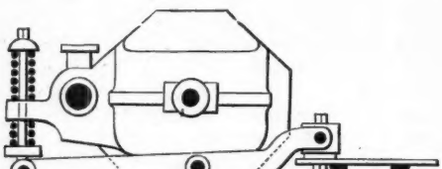


Fig. 5A.

The Side Bar Suspension (fig. 4) was first introduced by the General Electric Company, of America, its object being to relieve the weight on the axle. Two side bars support the weight of the motor on projections from the motor field casting (one of which is marked E in figure), these pivots being placed about the vertical plane of the centre of gravity. The side bars are supported at the axle end by jointed rods, F, connected with the truck, and on the other end by a channel iron and springs. Thanks to the position of the point of support, the weight of the motor is taken almost entirely by the truck. The old G.E. 800 motor used to have all three projections cast on the motor fields, so that either the nose or the side bar suspension could be employed.

The General Electric Company now generally use what is called the *Yoke Suspension*, shown in fig. 5. The effect is practically the same as the side bar arrangement, because the cross bar attached to the motor is usually bent back at its two ends, so the points of support are nearly in line with the centre of gravity.

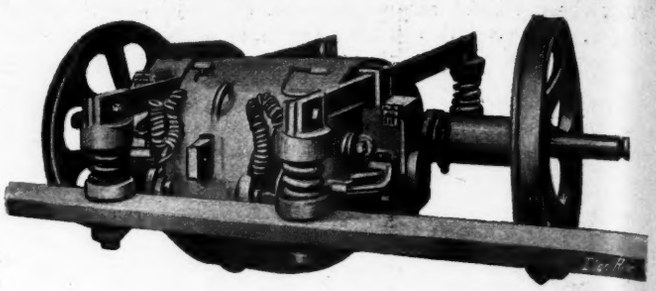


Fig. 6.

The *Schuckert Suspension*, see fig. 5A, is really a modification of the side bar suspension shown in fig. 4.

Top Bar Suspension, see fig. 6, was first introduced by the Westinghouse Company, and, like the preceding, it aims at placing the point of attachment approximately in line with the centre of gravity. Projecting from either side of the upper field casting is a lug into which are slipped the suspension bars. These bars are parallel to the sides of the car truck, and are supported at their ends by spiral springs which rest on channel irons, forming a part of the truck framing. Within the coils of each spring a bolt runs from the end of the suspension bar down through the channel irons, and between the nut on its lower end and the under side of the channel there is another light spring which

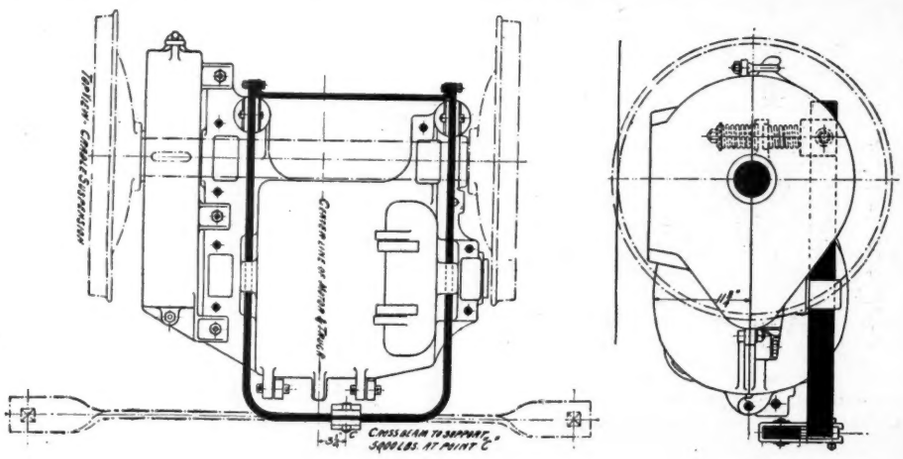


Fig. 7.

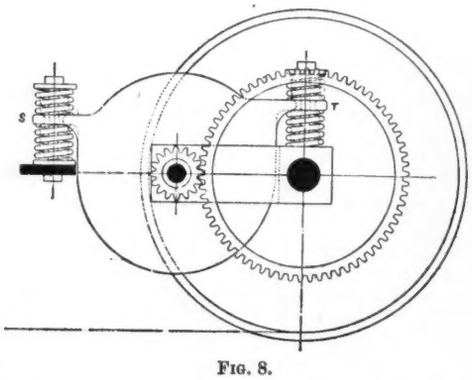


Fig. 8.

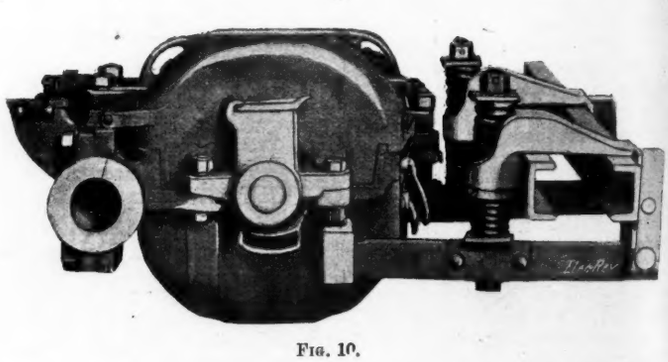


Fig. 10.

serves to overcome any tendency of the suspension bar to lift.

The *Cradle Suspension* shown in fig. 7 is a development of the top bar suspension. It consists of an iron cradle as shaded black, springs being placed at the two corners above the axle and also at either end of the cross beam, as in a nose suspension. In this way, although there are springs at four points, the motor is only suspended at three points, and thus readily rocks sideways with the motion of the axle.

Walker Double Spring Suspension.—The late Walker Manufacturing Company introduced the ingenious method of double spring suspension shown in fig. 8. In this case, although the gearing is kept in true alignment, the motor is yet able to rise and fall at either the end, S, or the end, T. Being cushioned at both ends, it rides like any ordinary suspended vehicle, and the movement, in fact, was at times so great that the company were led to dispense with the springs at S altogether, the modified arrangement as now employed by Messrs. Dick, Kerr & Co., Limited, and others being shown in fig. 9. The motor is now firmly supported

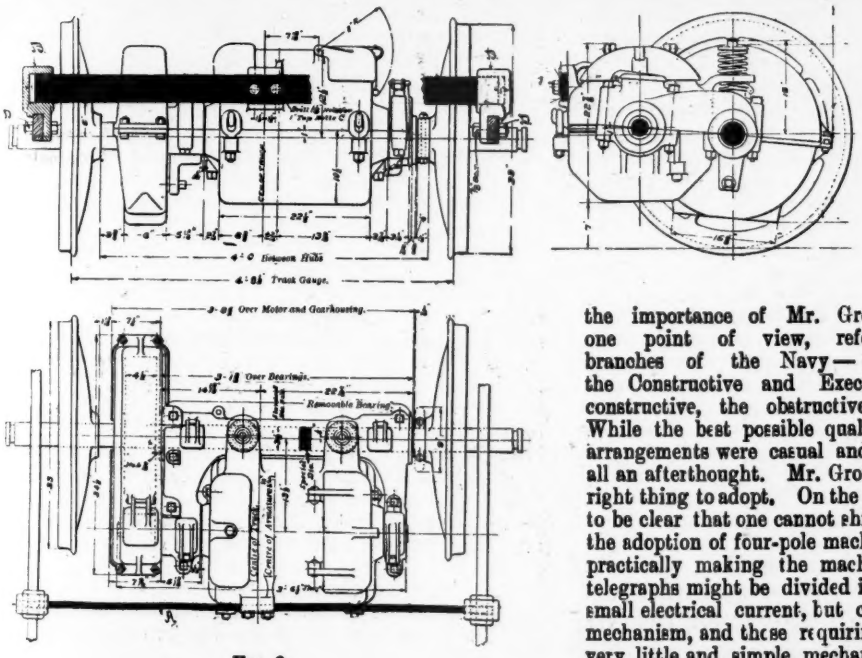


FIG. 9.

at the end farthest from the axle by means of the cross bar (shown shaded black) fixed to the truck at each end. Half the weight of the motor is thus supported by the truck and the other rests on springs immediately over the axle. This device appears to be better than any of the preceding from the point of view of suppression of hammering, because it reduces to a minimum the mass of the part fixed to the axle, and the springs are placed just where they are most effective.

The suspension employed by the Électricité et Hydraulique Société Anonyme is shown in fig. 10. It is a sort of side bar suspension, but the point of support is considerably to the right of the centre of gravity. All the bars, springs, &c., are kept well away from the region of the axle in a particularly neat manner.

With "nose suspension" the top bearing bush lasts about six months, and the lower bush, say, a year, but this time of duration may be doubled by the employment of the side top bar and other methods described. On the other hand, the gearing has been found to wear more evenly with the nose suspension.

(*To be continued.*)

INSTITUTION OF ELECTRICAL ENGINEERS.

AT the meeting of the Institution of Electrical Engineers, held on Thursday, the 5th inst., Mr. E. J. Wade replied to the discussion on his paper, "Storage Battery Problems," which had taken place at the previous meeting. He read his reply with an easy flow of language, and slaughtered his critics' arguments at a high rate. Answering Mr. Cooper, he said that if primary cells had been born secondary cells, the simple explanations of their action would probably hardly suffice. Dealing with lead sulphate, he reminded his hearers that Lord Kelvin and Dr. Lodge had been unable to reduce lead sulphate electrolytically. The conditions were not the same as zinc and sulphuric acid, as lead sulphate was insoluble and the molecules were unable to change their position. The question was: "Which is the true, not which is the simplest, theory?" The theory must explain the facts. He then dealt at some length with the difference between an extremely intimate mixture and an extremely feeble compound. He thought it well that we should have been reminded how much complexity and obscurity exists about the fundamental action—the electrolysis of sulphuric acid. He then dealt with porosity and loss of capacity of negative plates, and expressed his pleasure that the most trenchant portion of Prof. Ayrton's criticism was directed at the Electrical Cab Company and not at himself.

Mr. C. E. Grove then gave an excellent summary of his paper on "The Electrical Equipment of Ships of War," and the discussion was opened by Captain Creak, who said he did not know of any occasion on which wiring had affected the compasses of a ship, but dynamos were great sinners. Mr. Evershed, after urging the importance of Mr. Grove's paper from more than one point of view, referred to the three great branches of the Navy—the General Administrative, the Constructive and Executive Departments—as the constructive, the obstructive and destructive branches. While the best possible quality was put in, the electrical arrangements were casual and the electrical scheme seemed all an afterthought. Mr. Grove's power station seemed the right thing to adopt. On the question of shielding it ought to be clear that one cannot shield by putting iron on a coil; the adoption of four-pole machines got over the difficulty by practically making the machines astatic. Indicators and telegraphs might be divided into two classes, those taking a small electrical current, but containing a large amount of mechanism, and those requiring large currents but having very little and simple mechanism. The telegraph referred to in the paper and brought out by Mr. Richards and the speaker was practically an ohmmeter. The rudder indicator was of the same class. There had been only two failures, in the first, the gun practice also broke all the windows in the chart house, and in the second—a total failure—he had found that the keys of the switches had been locked up in the constructor's office the whole day, and therefore they had never been turned on!

Mr. Crompton referred to the fear and trembling with which he rose to criticise the naval authorities. He spoke strongly about the use (or non-use) of electricity in the Navy as a "disgrace to our profession." He pointed out that a Brazilian cruiser was the first war vessel to be fitted, and that the English authorities adopted the arrangements designed for that cruiser without paying royalty to the unfortunate contractor. He characterised the Navy projector as the worst projector in the world, and lamented that automatic projectors were not used by the home Government. Everything tended towards all the auxiliary plant on a warship being worked from one central station, and it would be much easier to teach the men who have to do the work the use of motors than of varied kinds of machinery, steam, hydraulic, and so on. The breakdown of a motor was so rare a thing as to be almost unknown. He had not yet heard of electrical conductors being frozen. Then there was the Willans engine. "Isn't it a scandal that the Willans engine should be kicked out of the Navy? and, gentlemen, you all know why!"

Mr. A. E. Richards spoke up for the Navy, and gave as the reason that automatic projectors were not used that the "proper people" did not consider them required. He

entirely by the truck. The old G.E. 800 motor used to have side of the channel there is another light spring which

agreed with Mr. Crompton as to the reliability of dynamos. Mr. A. A. C. Swinton did not quite agree with Mr. Crompton, as he considered that for the training of large guns hydraulic power was very much better, the slow steady motion was exceedingly well suited to that particular purpose. He had discussed with Mr. Parsons the reason why the steam turbine had not been more used on shipboard. The reply seemed to be that in the early days small sizes only were wanted, and the turbine was not very well suited for small power, while they were sometimes placed transversely across the ship, and the stresses were considerable when the ship rolled, the turbine forming a gyrostat.

Mr. Allingham asked some questions about lead-covered cables, and also if fibrous insulation had been tried; he talked of twin cables and primary batteries.

Mr. A. J. Lawson returned to the central station idea, and objected to generating sets being distributed all over the ship with long lengths of steampipe, when dynamos should be concentrated in the engine room. Again, the Admiralty have standardised in the wrong way by adopting an unusual voltage, and the sooner they went to 100 or 200 volts the better. Then the cables would be simplified, and a return to central station methods would produce better results in every way.

Mr. Grove, in his reply, pitted the opinion of Mr. Evershed, who thought our Navy was not behind, against that of Mr. Crompton, who thought it was very much behind. Mr. Grove believed we were too conservative. It takes years and years to make the British Admiralty see anything; if a novelty is proved to be a success in other navies or the marine, then it is adopted tardily. We ought to go in for a little more enterprise in a country like this, an opinion well received by the meeting. If there be any difference between a dynamo and engine, the advantage lies with the electrical machine. Mr. Richards was utterly wrong; ships are built, have been built, and will be built round, say, guns and Belleville boilers; why not round a central station? The hydraulic system has been fathered by Armstrong, and the combination of ordnance and hydraulic engineers explained its so general use. The electric system—say on Ward-Leonard's principle—worked equally well.

This closed the meeting.

TWO NEW FORMS OF MERCURY CELL FOR THE ELECTROLYTIC PRODUCTION OF ALKALIES AND CHLORINE.

By JOHN B. C. KERSHAW, F.I.C.

The advantage of using mercury as cathode material in cells for the production of caustic alkalies and chlorine, is due to the fact that mercury forms an alloy, or amalgam, with sodium or potassium at ordinary temperatures, and thus removes the liberated metal from the further action of the current. The most successful form of mercury cell yet devised is the Castner cell, the English patents of which are owned by the Castner-Kellner Alkali Company, who are now using 4,000 H.P. for operation of this cell at Weston Point, near Runcorn. A full description of these works and of the Castner cell appeared in the issue of the Electrical Review of March 31st, 1899.

The Rhodin cell (see Electrical Review, Oct. 29th, 1897) is another application of the same principle, but the proposed developments in England with this cell have been blocked by the infringement proceedings taken by the Castner-Kellner Company, and as the judgment in the lower courts has been reversed on appeal, the case is now likely to be carried before the House of Lords. The Rhodin cell is, however, about to be worked upon an industrial scale in America.

In each of these forms of mercury cell, the mercury lies on the bottom of the cell and the salt solution lies above it. The active surface of the mercury is, therefore, uppermost. When the current is passing through the cell, the amalgam forms upon the upper surface of the mercury, and being the lighter floats upon it as a crust. Diffusion of the amalgam into the unaltered mercury beneath it is slow, and, therefore, it is necessary to make provision for the removal and decomposition of this crust of amalgam at short intervals of time. In the Castner cell this is effected by a periodic tilting movement, which carries portion of the mercury and of the amalgam into an adjoining decomposing chamber containing water or dilute caustic soda solution.

In the Rhodin cell the transfer is effected continuously by the centrifugal action of revolving carbon anodes placed in

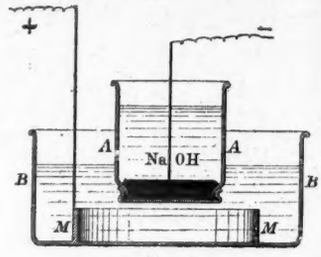


Fig. 1.

the central compartment of the cell. In the two new forms of cell which the writer is about to describe, mechanical movements are dispensed with, and the forces of gravitation are brought into play to effect the removal of the amalgam from the cells. The first of these cells is the invention of two Italians, MM. H. Crudo and J. Bisazza, and the Italian patent is dated December 13th, 1899. In this cell the *under surface of the mercury is the active part of the cathode, and as the amalgam forms it rises through the supernatant mercury*. The renewal of the cathode active surface thus becomes entirely automatic in character. A second novel feature of the cell is the use of sulphide of iron in order to effect the rapid decomposition of the amalgam when brought into contact with water. The inventors give a list of substances which have a similar effect, amongst others being oxides of manganese and cobalt. Since it has long been known that certain chemical substances and metals facilitated the decomposition of amalgams, it is questionable whether the patentees' claim under this head will stand. They have selected sulphide of iron for use in their own cell, as being most rapid in its action and least acted upon by the resultant alkaline solution.

Fig. 1 shows the simplest laboratory form of the cell. A is a glass or glazed porcelain vessel, provided with a porous bottom. The bottom of this vessel is covered with mercury, and above the mercury is the water or weak solution of

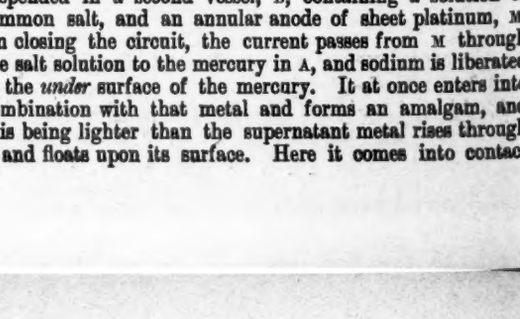


Fig. 2.

sodium hydrate. Electrical contact with the mercury is made by means of a spiral of iron wire. The vessel, A, is suspended in a second vessel, B, containing a solution of common salt, and an annular anode of sheet platinum, M. On closing the circuit, the current passes from M through the salt solution to the mercury in A, and sodium is liberated at the *under* surface of the mercury. It at once enters into combination with that metal and forms an amalgam, and this being lighter than the supernatant metal rises through it and floats upon its surface. Here it comes into contact

held on Thursday, the 5th inst., Mr. E. J. Wade replied to the discussion on his paper, "Storage Battery Problems," "proper people" did not consider them required. He

with the water and with the lumps of ferrous sulphide, and the amalgam is rapidly decomposed into its original mercury, and a solution of sodium hydrate with evolution of hydrogen gas. The ferrous sulphide undergoes little or no change, and its action would appear to be simply to supply the negative element in an electrical couple. Why it should be superior in this respect to metallic iron, which is used for a similar purpose in the Castner cell, is not by any means clear. Figs. 2 and 3 show other forms of the cell, designed for operation on a larger scale. It has been found, however, that with all these forms the chlorine passing from the anode compartment of the cell contains hydrogen.

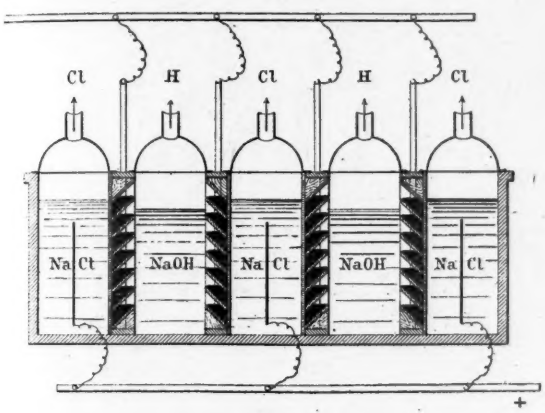


Fig. 3.

The inventors ascribe this to the decomposition of the water by the current passing through the anode compartment of the cell, but it is questionable whether this hydrogen does not arise from percolation of water through the diaphragm and from decomposition of portions of the amalgam on the lower side of the mercury cathode. Fig. 4 shows the form of cell which has been designed to overcome this defect. A is a porous tube containing the mercury, and connected with the cathodic compartment of the cell by the non-porous tubes B, K, and L. The amalgam formed in A is displaced by gravitation, and slowly rises and passes over into C—this upward movement being also assisted by any hydrogen that may be liberated in the tube A.

In C the amalgam is at once decomposed by its contact with ferrous sulphide and water, and the regenerated mercury finds its way back into A, by the tubes B and K. The enclosure of the mercury in a porous cathode tube, and the inclination of this tube in the anodic compartment of the

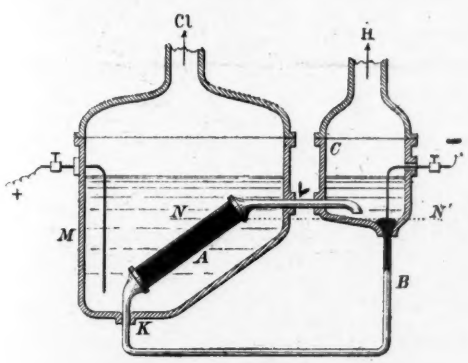


Fig. 4.

cell in the manner shown, thus causes both the hydrogen and the amalgam to be carried into the decomposing chamber by a movement which is perfectly automatic in character; and the chlorine passing from the anodic compartments of the cell, is entirely free from hydrogen.

The disadvantage of this cell, as compared with the Castner-Kellner or Rhodin form of mercury cell, is that due to the diaphragm between the anodic and cathodic divisions of the cell. Diaphragms are generally troublesome to keep in a high state of efficiency; and further, they increase the internal resistance to the passage of the electric current. As a set-off to this disadvantage, there is the gain due to the absence of mechanical rocking or driving devices. Actual trial on a fairly large scale can alone settle the balance of loss or gain; and from the figures given the writer judges that only laboratory trials with this cell have yet been carried out. Current efficiencies of 95 per cent. and 100 per cent. are stated to have been obtained, but these figures, without the corresponding figures for the E.M.F., are not of much value. At a later date the writer hopes to be able to give fuller figures for the operation of this cell.

The second cell to which it is desired to draw attention is the invention of Mr. J. W. Kynaston, of Liverpool, and is protected by English Patent No. 15,967, of 1898. Fig. 5 shows a sectional end elevation of this cell. The mercury is fed continuously into the cell by the supply pipes H H, and flows in zig-zag fashion over the narrow shelves which line the sides, until it arrives at the bottom of the cell, and is carried off by the pipe, J. The successive shelves are supplied with transverse ridges and run-off pipes at alternate ends. Each shelf is thus kept constantly covered with a layer of mercury $\frac{3}{8}$-inch deep, and only the lighter amalgam passes off from it to the one next below it. The feed of mercury, and the strength of current passing

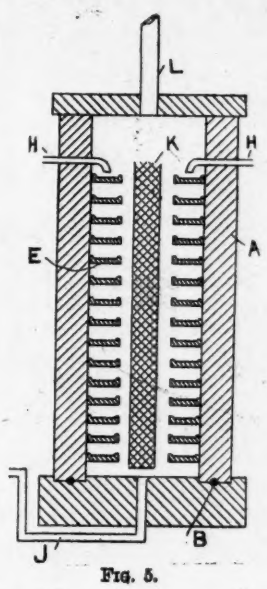


Fig. 5.

through the cell, is regulated so that the mercury passing away by the exit pipe, J, contains the maximum percentage of sodium possible for the temperature at which the cell is being worked. K represents the carbon anode, and L the exit pipe for the chlorine gas. The cell is fed with brine in the usual manner, and is to be worked at an elevated temperature. The amalgam drawn off at J is decomposed in a separate vessel, and the mercury is then returned to the cell by H H.

The advantages claimed for this cell are: the absence of any mechanical rocking devices, and the large cathodic surface available within a cell occupying but small ground space. The cell has not yet been tried upon a practical scale, and it is, therefore, too early to deliver any judgment upon its merits and demerits.

THE ELECTRICAL EQUIPMENT OF SHIPS OF WAR.*

(*Continued from page* 567.)

The installation of electric lighting on board a man-of-war dates from 1881, arc lamps in series being used. The parallel

* Condensed from a paper read by Mr. C. E. Grove at the Institution of Electrical Engineers, April 5th.

lighter floats upon it as a crust. Diffusion of the amalgam it and floats upon its surface. Here it comes into contact

glow lamp system, however, became standard practice almost as soon as it was introduced. The number of lamps employed has been steadily increasing, so that the *London* now building will carry from 1,000 to 1,050 lamps.

It is usual to arrange the electric lamps in six circuits, one circuit being exclusively devoted to engine and boiler rooms, one to magazines, one to the central citadel, one to the crew spaces forward, one to the cabin spaces aft, and one to the stores and machinery rooms below the belt deck. It is desirable to have separate circuits for those portions of the ship which are protected by armour, rather than to mix up the lighting of protected and unprotected portions, though this is by no means generally done. In the U.S. Navy the lamps are arranged on two main circuits, known respectively as the "battle" circuit, which includes the lighting of all parts of the ship occupied in action, and the "lighting" circuit, which includes those parts where general illumination is required for ordinary purposes. Feeders running from the switchboards connect to the respective circuit networks through junction boxes.

Fig. 5.—Cable Work behind Switchboard showing Tubular Watertight Glands.

Lead-covered cables and wires, first introduced into the Japanese cruiser *Naniwa-Kan*, built at Elswick, are universally used in our Navy, and the insulation is now vulcanised india-rubber in all cases. For single lamps a pair of 1/16 wires are employed; stranded wires which group the sets of lamps through fuse boxes up to the circuits are universally composed of multiples of single 20-wire, the standard sizes being 7/20, 11/20, 15/20, 30/20, 60/20, 80/20, and 150/20; while for dynamos and heavy motor circuits 350/20 and 550/20 are employed. The current density is usually a little below 1,000 amperes per square inch, which ensures in the lengths dealt with a very moderate voltage drop. The Japanese have, in their latest battleships, had the cables and wires attached directly to the decks and bulkheads, dispensing with backings, except where necessary for the heaviest runs or as packing to carry heavy runs of the larger cables over obstructions such as flanges of angle-bars, rows of rivet-heads, and the like. This makes a very substantial and satisfactory job. The practice in the U.S. Navy very much resembles land practice. None of the methods adopted in foreign navies appear to be so safe or so thorough as the British Admiralty method of lead-covered cables closely packed together, and visible and accessible throughout their length.

Where the wires go through watertight bulkheads or decks, of course the bulkheads and decks must be made watertight behind them. A simple, compact, and effective method is as follows:—Two pieces of wrought-iron plate are drilled with holes slightly larger than the size of the cables that are to go through the bulkhead; similar blocks of india-rubber about ½ inch thick have holes formed in them just the neat size of the cable; the bulkhead is drilled with clearing holes; a slab of rubber and an iron plate are placed on either

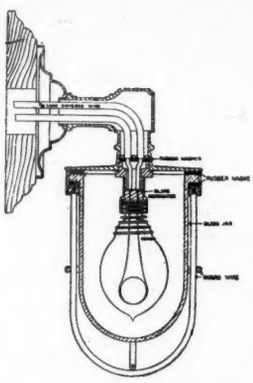


Fig. 6.—Admiralty Pattern Watertight Bracket.

side of the bulkhead, the cables are drawn through, and then the plates screwed up tight. By this means pressure is put upon the rubber, which tends to make the holes through which the cables pass smaller, so that the cables are gripped, and the holes are left watertight.

A new arrangement (fig. 5) was introduced by the British Admiralty in 1898. Brass glands of tubular form screwed to take a nut at one end, and having central holes, previously tinned, about ⅛ inch larger in diameter than the cable intended to pass through, are inserted in the bulkheads and made watertight on the iron by means of red lead. The lead-covered cable is drawn through, and its tape stripped back to bare the lead at the gland, a split tinned ferrule is then inserted to fill the clearance space around the cable, and the whole is then sweated up solid by means of a blow-pipe.

The main circuit cables from the switchboard pass, in the case of the heaviest circuits, though "junction boxes," into which they split usually into two branches protected by fuses. Each of these branches then passes through a series of "section boxes," which are circular watertight boxes containing a switch and four pairs of terminals for the attachment of fuses and the branching of cables. Each of the four pairs of cables running from a section box terminates in a "distributing box," which is a similar box to the section

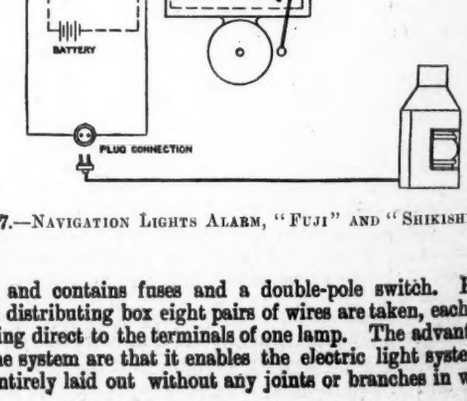


Fig. 7.—Navigation Lights Alarm, "Fuji" and "Shikishima."

box, and contains fuses and a double-pole switch. From each distributing box eight pairs of wires are taken, each pair leading direct to the terminals of one lamp. The advantages of the system are that it enables the electric light system to be entirely laid out without any joints or branches in wires,

thus dispensing at once with what is usually an important source of trouble.

Fig. 6 illustrates a typical Admiralty watertight fitting, showing the method of wiring. The lead-covered wires are drawn through an india-rubber washer pierced with two holes, which fits tightly into the neck of the fitting, thus excluding moisture; the lead and the insulation are then stripped back, and the bare wires led through holes in a slate disc which forms a separator; no lampholder, properly speaking, is used, but the ends of the wires are turned back with pliers to form hooks, and on to these bottom loop lamps, having twisted spiral platinum loops, are hung. Loop lamps are used because they best stand vibration and shock due to gun-fire. But this method of wiring is capable of considerable improvement. If the hooks in the wires are not properly formed and are not of exactly the right length, bad contact and sparking result, and the wires are burnt. If from any reason the hooks get injured or broken off, little pieces of wire have to be soldered on, which is not good. It would be much more satisfactory if the wires terminated in fixed contact blocks, and the fitting, wired complete and provided with spring contact plungers, were then independently attached.

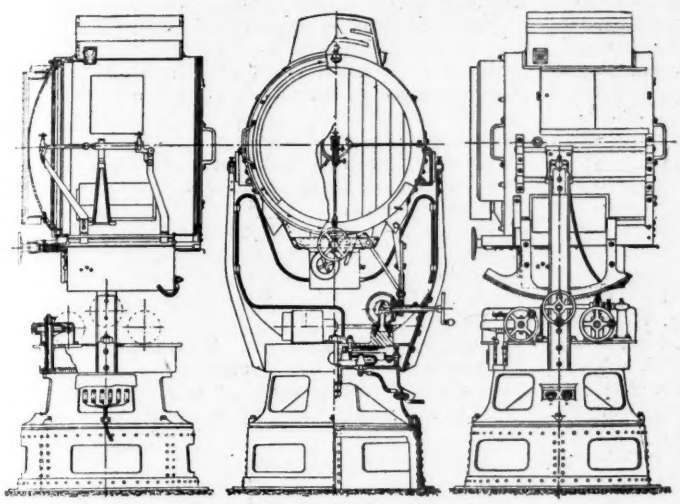


Fig. 8.—Schuckert Automatic Projector.

Every ship, of course, carries the ordinary international navigation lights, port side red, starboard side green, and masthead white, which must be alight all the while the vessel is under way, together with white riding lights, which have to burn when the ships is at anchor. In British ships, so-called "position lanterns," two in number, are carried on the ensign staff when at anchor. In order to provide against failure of the navigating lights, the lanterns sometimes contain two lamps with an automatic switch for throwing the second into circuit if the first fails. This does not, however, make a good arrangement, because both lamps cannot be placed in the focus on the Fresnel lens, and if one is right the other one must be out of position. Tell-tale alarms (of which there are several kinds) are used on some ships to give warning if one of the navigating lights fails. Fig. 7 shows the arrangement devised by the author for the *Fuji* and *Shikishima*. An electric bell is provided with a relay wound to $\frac{1}{10}$th of an ohm and carrying the full current of the 50-C.P. lamp employed, say, 2½ amperes. This relay magnet holds a spring contact out of connection with the bell circuit while the lamp current is on. On the failure of the lamp current the spring contact completes the bell circuit, and the bell rings continuously. A duplex switch in one watertight case switches both lamp and bell circuit on together. A plug connection is attached near the lamp position, so that the lamp can be removed without disturbing the wiring. The bell circuit can be tested by merely switching on with this plug connection out, when, of course, the bell will ring if all is in order.

For general fleet signalling, flashing lamps carried at the truck of the foremast are in fairly general use. They are designed so that any communication can be effected by the use of the ordinary Morse code.

The searchlight installation is usually considered one of the most important sections of the ship's equipment, and use was found for searchlights five years before electricity was used for the general illumination of ships. The Parsons mirror is now standard in our Navy, and is a thin parabolic mirror of high quality. The inclined hand-feed lamp is commonly employed; the carbons are tilted about 20° from the vertical, and the light falling upon the mirror has its maximum intensity at or near the centre of the mirror. On the Continent and in the United States automatic horizontal carbon lamps are coming into favour. The crater of the positive carbon is, of course, turned towards the mirror, the arrangement in this case giving the maximum intensity of the light at the outer edges of the cylindrical beam. The British War Office has also adopted the horizontal carbon lamp for its standard projectors. The ascending current of air is apt to displace the arc, which is specially inconvenient with horizontal carbon lamps. To get over this difficulty the Schuckert projector, fig. 8, which is standard in the Austrian Navy, is fitted with a soft iron ring surrounding the carbon. This ring becoming magnetised when the current flows produces a magnet field along its axis which the carbon lies, and so keeps the arc in the proper position.

Searchlights are used a good deal now for long-distance signalling, and very great distances indeed have been covered. The common way is to make use of a round disc suspended on a spindle running through the projector barrel between the lamp and the mirror, and vibrating this disc by means of a small lever-handle on the spindle. In some recent foreign projectors a flashing screen, resembling somewhat a Venetian blind with the lathes vertical, has been fitted in front of the front glass; the lathes are linked together, and their movement from the position in which the full light is shown to that in which all the light is cut off, is controlled by a small lever-handle mounted at the side.

CORRESPONDENCE.

Economy of Mechanical Draught.

I am interested in any facts or information concerning mechanical draught, but although I have gone into the matter, I cannot claim, as Mr. Steavenson does, to have studied the subject for 35 years; if pressed, I might acknowledge to as many months.

Nevertheless, I consider he looks at the subject from one point of view, and I would fain try and put the other side in the balance. For argument's sake, I take Mr. Steavenson's own figures, and simply bring in the running cost of the chimney. To obtain 1 inch water pressure by chimney or natural draught will require the waste gases to be 500° F. at least with a chimney 140 feet high. With mechanical draught these gases can be reduced by use of an economiser to between 200° and 300° F., say to the latter. Then as the 5,000 cubic feet of air with the coal gas will be 419 lbs., we have 419 lbs. of gas × 200° F. × ·238 = 19,600 B.T. units. Say 1 lb. of coal contains 14,000 B.T. units. Then the 19,600 B.T. units = 1·4 lbs. of coal per minute, or 84 lbs. per hour.

If we allow 8 lbs. of coal per hour for 1 I.H.P., then we have 10½ H.P. per hour as the amount saved by mechanical draught, or as the running cost of the chimney draught. That is, the running cost of the chimney draught is 5¼ times that of the mechanical draught.

As Mr. Steavenson gives the cost per annum of mechanical draught for nine boilers as £648, then for the chimney draught it will be £648 × 5½ = £3,402—a tall order certainly—but then Mr. Steavenson's boilers never stop a minute from doing their highest duty from year's end to year's end. I know of a fan installation for three boilers, which has been working without trouble about 30 years; the first cost was probably not £100.

With an installation of fan (induced draught) with four boilers, put in by my advice, the waste gases go to the chimney at 234° F.

On the side of mechanical draught also comes greater reliability and independence of variation in atmosphere, and almost certainly it is the root of the solution of the smoke question.

J. E. W.

Fairfield, *April 5th*, 1900.

British Naval Engineers.

I am very pleased to see that you are taking up the question of the position of the engineers in the English Navy. As matters stand at present, the Admiralty are riding for a fall, and a very bad one, as hard as they can. The present system is a return to the days when, practically, there was no navy—when troops were carried in hired ships, whose crews fought occasionally, but whose principal work was the navigation of the ship. When the ship's captain, or sailing master, as he was afterwards called, had laid his ship alongside the enemy's, his work was done, and it was to a large extent his duty to keep his crew out of the fight, so that they might be at hand to haul the ship away when required, or to follow the enemy when required.

In Nelson's and in Hawke's time, the fighting element and the navigating element had become blended, very much to the advantage of the service, and our most glorious battles were fought by men who knew exactly what they could do with their ships, and the exact effect of each sail they carried. The battle of the Nile was fought and won as much because Nelson and his captains were seamen, and could handle their ships, as because they could fight. So much was this the case, and so superior were our naval officers in those days to the French, that the French admiral considered it impossible for the English fleet to engage him in the way it did, and actually left his guns on one side—the side he thought was unassailable—practically unworkable. It was the same with Hawke at Quiberon Bay. The French admiral thought Hawke dare not follow him into the bay with a gale of wind behind him. And it must be understood that it was no foolhardy, daredevil trick that either Nelson or Hawke played. It was the action, in each case, of a man who thoroughly understood the machine he was handling, and what he could do with it.

Perhaps the matter will come more forcibly before the minds of your readers when it is pointed out that there are at least 100 auxiliary engines in a modern battleship in addition to the main engines, while in the old sailing line of battleship there were only 30 sails, all told, including storm sails. But in the old sailing ship, whatever her size or rating, every executive officer was familiar with every portion of every sail, with every rope belonging to every sail, and with every accessory. The executive officer was trained from the very first to know the use and how to handle everything connected with ropes, sails, masts, boats, and, in fact, everything connected with the working of the ship under all conditions. He also knew the place which each individual man under his charge occupied on every occasion, and the work he had to perform. He knew what a man, what a sail, and what the ship could do under all circumstances.

And the results were something startling. It was no uncommon thing for the principal sails of the ship, the topsails, and courses to be shifted, the shifting usually involving the taking in of nearly all the other sails in 12 minutes. In fact, there is one record case where the *Orlando*, going into Malta harbour before a light breeze, with every stitch of canvas that could be crowded on her, shifted topsails and courses, taking all the other sails in except the fore and aft sails, and re-setting everything in eight minutes. Compare this with the four hours required when Cervera made his dash.

I believe myself—I give the opinion for what it is worth—that there is only one remedy, viz., to combine the executive and engineering branches. Cadets in the old sailing days were trained in seamanship and in navigation at the same time, and there was no difficulty about the matter. Let them now be trained in engineering and navigation, and such seamanship as survives, at the same time. The training of an engineer is the very best the young seaman could have in these days. With a good engineering groundwork, his other work, navigation, gunnery, &c., will come very much easier to him than it does now.

His whole career should be one of engineering, of the very highest order. The ship is a huge engine herself, the guns are engines; the handling of groups of ships, so that they will not be dangers to each other, as well as to the foe, is an engineering problem. The most advanced thinkers in the Naval service fully realise this, as a perusal of the service literature will show; but no man, however thoughtful, or however talented, can do much against the dead weight of an obsolete system.

There is, perhaps, one word of warning that should be uttered before concluding this letter. In Nelson's, and in Hawke's time, we were undoubtedly better seamen than the French. Our admirals, and our captains, could do and dare with English ships what no French admiral or captain could with theirs. It is not so now. If the reports that reach us, from those who have met French men-of-war at sea, are to be credited, French captains are at least as skilful, if not more so, in handling their ships than our own.

Sydney F. Walker.

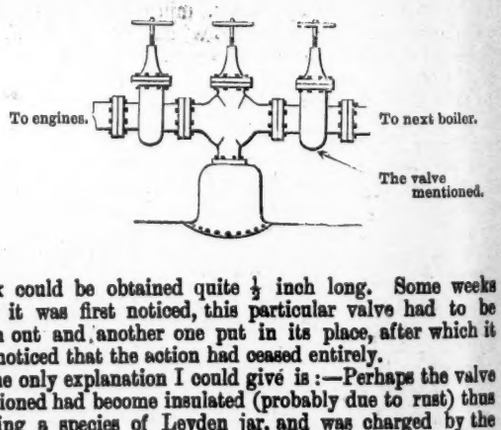
Bath.

Hydro-Electric Phenomena.

In the Electrical Review of December 22nd, 1899, there appeared an account of a strange action displayed by a boiler at an electrical works in Birmingham.

A similar phenomenon presented itself at Foy & Gibson's boiler room (Collingwood) during the earlier part of last year.

In this case if a person were to stand on the boiler plates and approach the hand to one of three valves which were coupled together, quite a severe shock could be felt, and a



spark could be obtained quite ½ inch long. Some weeks after it was first noticed, this particular valve had to be taken out and another one put in its place, after which it was noticed that the action had ceased entirely.

The only explanation I could give is:—Perhaps the valve mentioned had become insulated (probably due to rust) thus forming a species of Leyden jar, and was charged by the action of the steam. However, at the time I did not attach any importance to it beyond its analogy with Armstrong's hydro-electrical machine.

Sydney A. M. Rose,
Elec.

Test of a Ventilating Fan.

I worked at this question for many years, and have given it up because I found that as fast as I smashed one fallacy, half a dozen sprang up in its place. I am very unwilling to reopen the subject, but as I think I can explain some of the present apparent difficulties, I will shortly try to show how they arise.

I have found—and should have no trouble in proving it—that the more unfit a fan really is for the work to which it is applied, the higher will appear to be its efficiency. That will seem a paradox; it arises in this

For general fleet signalling, flashing lamps carried at the

that of the mechanical draught.

way:—The vacuum, or apparent vacuum, is a function of the speed of the periphery; result, put a fan on a mine 20 feet in diameter, in a case in which a 30-feet fan should be applied to give, say, 60,000 feet under an inch water gauge—that is, the mine will give that quantity under that gauge, but having put up a fan which is too small, you are obliged to run the small fan at a speed which gives, perhaps, 2 inches at the fan. Now you have got what I have long called the pseudo W. G., and you can prove it, as I have done scores of times.

In such a case, start with the 2 inches at the fan; now go 10 yards away—you get, perhaps, 1¾ inches; go 10 yards further away, you get 1½ inches; finally, go away until at, say, 25 yards, you get the 1 inch, which is the true water gauge of the mine, and under which a proper sized fan would have worked.

Now you see where the fallacy comes in, you measure the air, eight times out of ten the measurement is wrong (because those who do it, don't understand the nicety of the operation), they think there is nothing to do but read the anemometer, read the water gauge, and there you are; why, I can show you a letter years ago in one of the technical journals from a professor who laboured to prove that he had got more than 100 per cent. of efficiency. The question of the air measurement will take more time than I can on the present occasion give to it, but let those who want to understand the centrifugal ventilator, get and read a book I published in 1883, it is a translation of a paper by Mons. Murgue, to which I added an introduction, and is sold by Messrs. Spon.

I doubt very much whether these baby fans used for boilers are capable of being accurately tested, they don't admit of proper tests either of the water gauge or the volume of air; an experimenter can get any results he likes out of them if he knows how to go about it.

On one occasion I had to go to the top of the chimney to get a fair measurement, there being no room to do it properly in the mine, and the result was I knocked a result down from 80 per cent. to something like 50.

A. L. Steavenson.

Information Wanted.

I should be glad to know whether any of your readers have had experience in the driving of stones by electric motors for grinding Indian corn, beans, &c., and with what success.

G. R. Peers.

April 9th, 1900.

Wiremen's Woes.

It is high time that the state of affairs spoken of by "H. W. H." in your issue of March 23rd were put an end to. We are continually having our attention called to articles and letters in the papers on the dangers of jerry wiring, yet nothing seems to be done to root out the jerry wirer.

He gets on to a job as a helper, labourer, or perhaps as a carpenter, sees a bit of wiring done, and then bursts forth a full-fledged wireman. As in nine cases out of ten he starts for a much lower wage than a really capable man would require, he generally manages to secure a post.

In addition to the fact that it is unjust to the wireman who knows his business thoroughly, he only manages to waste good material, and generally brings discredit upon everyone and everything connected.

I know of a case where a man who has been a sailor on a tramp, fireman on a trawler, a steam crane driver on the Manchester Ship Canal, and finally wireman in a shipyard. In a short time he manages to get charge of one of the largest, if not the largest, polyphase plants in the North of England.

It is needless for me to add that this man's ideas of three-phase generators and motors, and the running of the same, are entirely original.

Still, he manages to keep things going, and though he does get things mixed, and shuts the entire works down at unexpected moments, he can always work out a good case against the engines or the driver thereof.

The works' manager who thinks he knows a thing or two, or who is under the impression that he has got a good man at a bricklayer's rate of wage, goes back to his office satisfied. When his men apply for an advance of wages, he tells them that the management is doing very well to pay them such wages for work that any sailor can do in a couple of months.

Another instance in the same district is that of a sailor who trimmed arc lamps in a shipyard for a few months, and then gets charge of a continuous current power and lighting plant, and is, in addition, wiring ships.

Of course at regular periods he gives free firework displays in his power house, and the employés in the yard go in fear and trembling within handling distance of his motors. Yet this man can dash around the power station, an oil can in one hand, and a spanner in the other, with such splendid effect, that the works' manager is positively gratified, and remarks, as a spare armature is being fitted, that "It's a pity electric driving is so uncertain."

I quite agree that this state of things should never be tolerated, but it seems to me that it requires something more than "merely being made known" before they are abolished altogether.

Wireman.

I have read both letters on this subject in your recent issues, and can fully endorse the principle of "H. W. H.'s" contention, although I have never seen a "labourer" in charge of installation work. When acting as foreman recently for a well-known firm of contractors, I had under me a young fellow with neither electrical nor mechanical knowledge, who was in receipt of 7d. per hour, and although he was a dead loss to my employers, they persisted in keeping him on; this is not a solitary case, I knew of many. Contractors expect their foremen to put up good work cheaply and quickly with two or three good men and half-a-dozen deadheads.

"J. B.'s" arguments may be correct in his own case, but my experience convinces me that contractors, as a rule, are poor judges of a man's ability. They prefer the glorious uncertainty of a learner at 6d. an hour to an efficient man at 9d.

H. S.

THE ACTION OF CARBON UPON REFRACTORY OXIDES AT HIGH TEMPERATURES.

By ALEC. A. BEADLE, A.I.E.E., F.C.S.

The scope of modern chemistry has been much widened by the large range of temperature through which reactions can be studied, by the production of low temperatures on the one hand, and by that of high temperatures on the other.

The temperature of the ordinary regenerative furnace, which may be taken as the highest practically obtainable by the combustion of fuel, is limited in several ways. The high specific heat of the nitrogen with which the oxygen of the air is diluted, the volatilisation of the products of combustion and the temperature limit of the carbonic oxide and water vapour before they become dissociated, all tend to prevent the heat from rising to such an intensity as would otherwise be possible. Suggestions have been made for burning the fuel under greatly increased pressure so as to raise the temperature of dissociation, but the impossibility of finding materials infusible enough for such a furnace, as well as the many obvious difficulties in the way of stoking and feeding with air have so far prevented its development. Were it possible to free the air of its nitrogen and other diluents at such a cost as would enable it to be used for large furnaces, one step in the right direction would have been made, but up to the present this has not been possible.

At present, therefore, the maximum temperature practically obtainable in a regenerative furnace is from 1,700° to 1,800° C.,* and is not likely to be much increased. That of the oxyhydrogen furnace is about 2,000° C.

The highest temperature actually obtainable is produced

* Kohn.

Cervera made his dash.

efficiency. That will seem a paradox; it arises in this

in the electric furnace by taking advantage of the transformation of electrical energy into heat when its passage is resisted.

Those factors which combine to limit the temperature of a combustion furnace have no relation to the electric furnace, the temperature of which is simply limited by the volatilising point of the substance heated. Since carbon, the conducting medium of the electric furnace, is one of the least volatile conductors with which we are acquainted, its boiling point may be taken as the highest temperature obtainable in the electric furnace. Thus it is possible to obtain a temperature of about 3,500° C.* As it is only limited by the volatilisation of the substances contained in the furnace or by that of the products of decomposition, it would be possible to raise its intensity by subjecting to enormous pressure, and as the electric furnace lends itself to such treatment, we may expect that it may one day be taken advantage of. Increased pressure may also help the reactions to take place in some instances.

In an electric furnace the current is first conducted by the carbon electrodes, but these, when once hot, are generally separated, so that the molten charge, generally consisting of a mixture of powdered carbon and some refractory oxide, has to convey the current itself. There is some doubt as to how this conduction takes place, but it appears to be partly from particle to particle of carbon and partly through the molten oxide, which has then become an electrolyte. Whichever is the case the result would be almost exactly the same, as may be shown. Suppose that the carbon alone conducts, then the temperature of each particle so conducting is raised until such a time as it is sufficient to cause it to combine with the oxygen of the oxide and so liberate carbonic oxide and the metal; if now another particle of heated carbon be in the neighbourhood of the liberated metal then it will combine with it to form a carbide.

The same reactions would occur if we consider the conduction to be electrolytic from carbon to carbon particle through the medium of the oxide as electrolyte. One side of the particle will be acting as an anode while the other is acting as a cathode. On the anode side oxygen is liberated, and, being in its nascent state, immediately combines with the carbon to form a carbide. If the carbon is in excess of that required to satisfy the oxygen of the oxide, then any further electrolytic decomposition is followed by a recomposition, so that the carbide is never permanently decomposed.

If, however, the oxide is in excess, the carbide, acting as the electrodes, has its carbon gradually dissolved out and evolved as carbonic oxide on the anode side, until at last nothing but the metal remains. If this action does take place in the electric furnace, then, even when the oxide is in excess, carbides would be formed at the beginning of the reduction.

It is difficult to say whether any such electrolytic action does take place. If it does there is every reason to believe that it is often accompanied by violent local action, for many of the reactions of the electric furnace can be made to take place by means of sufficiently high temperatures without the aid of electricity. Thus many of the metals can be reduced at about 1,500° C. from their oxides by means of carbon. According to Hall, calcium carbide can be produced at a temperature of 1,020° C. Bergmann also produces calcium carbide in the blast furnace by burning a mixture of coke and lime with oxygen.

High temperatures have also been obtained by causing a highly electro-positive metal to re-act with the oxide of a less electro-positive one, thus Goldschmidt reduces chromium with powdered aluminium. He also produces sufficient heat; by igniting a mixture of an easily reducible oxide and powdered aluminium, packed round an iron rivet, to make it white hot. Menke reduces caesium from its hydroxide with magnesium powder. Possibly the carbides might be made in a similar way.

Generally speaking, there are two reactions which can take place when an oxide and carbon are heated together; first, the reduction to the metallic state; and secondly, the production of the carbide of the metal. It depends upon the proportion of the carbon to oxide introduced into the furnace as to which of these takes place. Table A shows the amount of carbon theoretically required to produce these reactions and the nature of the carbide when formed.

The first column gives the names of the metals (or non-metals) which have been subjected to reduction with carbon at a high temperature. The second gives the oxide most easily obtained, the third, fourth, fifth, and six columns give the percentage of oxide and carbon required to produce the metal and carbide respectively. These are the theoretical percentages, and it should be remembered that when endeavouring to produce the metal the theoretical proportion of carbon should not be exceeded, otherwise some carbide may be formed; whereas if the carbide is required the theoretical proportion of oxide should not be exceeded, otherwise the metal may be formed with the carbide. The seventh column gives the formula of the carbide produced, and the eighth the authority from whom the formula has been taken.

It is not absolutely necessary that the oxide should be introduced as such, but the metallic salts, which are capable of calcination to an oxide or a mixture of oxides, may be used. Thus sulphates, carbonates or other more complex salts may be mixed directly with the carbon.

In this way Steinberg and Deutsch mix together calcium chromite and carbon, and heat to a temperature of from 1,000° to 1,200° C., in which case metallic chromium is formed thus :—

$$2\,CaO, Cr_2O_3 + 3\,C = 2\,CaO + 3\,CO + 2\,Cr.$$

And similarly with the tungstate, tungsten is formed thus :—

$$Ca\,WO_4 + 3\,C = CaO + 3\,CO + W.$$

The following table shows the various metals which can be produced in this manner :—

Table B.

Salt.	For production of metal.		Metal produced.
	Per cent. of salt.	Per cent. of carbon.	
Calcium chromite ...	90	10	Chromium.
„ chromate ...	75	25	„
„ titanite ...	80	20	Titanium.
„ manganate...	75	25	Manganese.
„ molybdate ...	80	20	Molybdenum.
„ tungstate ...	86	14	Tungsten.
Sodium bichromate...	60	40	Chromium.
„ molybdate ...	75	35	Molybdenum.
„ titanite ...	70	30	Titanium.
„ tungstate ...	60	20	Tungsten.

Space does not permit of going carefully into the individual properties of each metal or carbide produced through the reducing action of carbon by the above-described methods, but it is these properties which make the whole question of their production interesting both from a scientific and a commercial standpoint.

Table D is, however, an attempt to describe in short some of the most useful properties of the carbides which are not generally known.

Two of these only have come into commercial use; first, calcium carbide, on account of its well-known property of evolving acetylene when decomposed by water, thus:

$$Ca\,C_2 + 2\,H_2O = C_2H_2 + Ca\,(OH)_2;$$

and secondly, silicon carbide ("carborundum"), on account of its excessive hardness, which is between sapphire and diamond. It will be seen from the table that both these carbides might be replaced by others. Thus boron carbide (B_6C) would replace silicon carbide, Barium carbide, strontium carbide or lanthanum carbide might replace calcium carbide, but for the value of their respective bases.

The amorphous carbides are nearly always black, but there is reason to believe that many of the crystalline substances would be colourless if perfectly pure.

The reactions which take place when some of the carbides are decomposed with water are perhaps their most interesting features.

Thus, manganese carbide evolves a mixture of methane and hydrogen, according to the equation,

$$Mn\,C + 6\,H_2O = 3\,Mn\,(OH)_2 + C\,H_4 + H_2.$$

Those of the cerium group evolve methane and acetylene, thus:

* Moissan, Violle.

against the engines or the driver thereof.

Kohn.

E

TABLE A.

Metal.	Oxide.	For production of metal.		For production of carbide.		Formula of carbide.	Authority.
		Oxide.	Carbon.	Oxide.	Carbon.		
Aluminium ...	Al_2O_3	74	26	65·5	34·5	Al_4C_3	Moissan.
Barium	BaO_2	87·5	12·5	78	22	BaC_2	Mühl, Maquenne.
Boron	B_2O_3	66	34	59·5	40·5	BC	Wahl & Greene.
"	B_2O_3	66	34	63·5	36·5	B_6C	Moissan.
Caesium	Cs HO	89·5	10·5	86	14	Cs_2C_2	?
Calcium	Ca O	82·5	17·5	61	39	CaC_2	... ...
Cerium	CeO_2	87·5	12·5	98·5	21·5	CeC_2	Bullier.
Chromium ...	Cr_2O_3	73·5	26·5	...	...	Carbide containing 8·6 to 11·9 per cent. of carbon.	Mühlbäuser.
Copper	Cu O	...	...	...	...	Takes up a little carbon.	Moissan.
Gold	Au_2O_3	...	...	...	...	Does not dissolve carbon.	"
Iron	Fe O	86	14	82	18	Fe_3C	De Benneville.
Lanthanum ...	La_2O_3	90	10	79·5	20·5	LaC_2	Bullier.
Lead	...	...	...	...	...	Does not dissolve carbon.	Moissan.
Magnesium ...	Mg O	71·5	28·5	45·5	54·5	MgC_2	?
Manganese ...	Mn_3O_4	82·5	17·5	79·5	20·5	Mn_3C	Wahl & Greene.
Molybdenum ...	MoO_2	...	...	...	...	MoC_2	?
Potassium ...	K_2O	88·5	11·5	72·5	27·5	K_2C_2	Mühlbäuser.
Selenium ...	SeO_3 (or non-volatile selenite)	82·5	17·6	68	32	SeC_2	?
Silicon	SiO_2	71·5	28·5	62·5	37·5	Si C (carborundum)	... ...
Silver	Ag_2O	...	...	...	...	Takes carbon up at its boiling point, separates out as graphite on cooling.	Moisson.
Sodium	Na_2O	84	16	63·5	36·5	Na_2C_2	?
Strontium ...	Sr O	89·5	10·5	74	26	SrC_2	Bullier.
Thorium	ThO_2	91·5	8·5	84·5	15·5	ThC_2	Kohn.
Titanium ...	TiO_2	87	23	69	31	Ti C	"
Tungsten ...	WO_3	86·5	13·5	84·5	15·5	W_2C	Moissan.
Uranium	U_2O_3	89	11	80	20	U_2C_3	"
Zirconium ...	ZrO_2	83·5	16·5	77·5	22·5	ZrC	Kohn.

TABLE D.

Carbide.	Hardness.	Density.	Appearance.	Action of, upon ordinary air.	Action of, upon water.	Authority.
Al_4C_3	...	2·36	Hexagonal laminæ	Little or none.	Slowly evolves methane (CH_4)	Moissan.
BaC_2	...	...	...	Slowly decomposed	Evolves acetylene (C_2H_2)	Wahl & Greene, &c.
BC	...	...	Metallic lustre.	Unacted upon.	Unacted upon.	" "
B_6C	Harder than Si C (nearly 10)	2·51	Black crystals.	Unacted upon.	Unacted upon.	Mühlbäuser, Moissan
Cs_2C_2	...	...	...	...	... ...	... ...
CaC_2	...	2·22 at 18°	Black.	Slowly decomposed.	Evolves acetylene.	... ...
CeC_2	...	...	...	Slowly decomposed.	Evolves mixture of methane and acetylene.	Moissan.
Chromium carbide	...	...	Black crystals.	No action.	No action at ordinary temperature.	... ...
Fe_3C	...	...	...	...	Slight action, paraffins (butane) and olephines detected (?)	Warren.
LaC_2	...	...	...	...	Evolves acetylene.	Bullier.
MgC_2	...	...	...	...	... ...	... ...
Mn_3C	...	6·89	...	...	Evolves mixture, methane and hydrogen.	Moissan.
Mo_2C_3 (?)	...	...	Black crystals.	Unacted upon.	Unacted upon at ordinary temp.	Moissan.
K_2C_2	...	...	...	...	... ...	... ...
SeC_2	...	...	...	...	... ...	... ...
Si C	9 to 10 (nearly 10)	3·23	Black (pure colourless)	No action.	No action.	FitzGerald.
Na_2C_2	...	...	...	...	... ...	... ...
SrC_2	...	...	...	...	Evolves acetylene.	Bullier.
ThC_2	...	...	...	Some action.	Evolves acetylene, methane and hydrogen.	Kohn.
Ti C	...	...	...	No action.	No action.	Kohn.
W_2C	...	...	Black crystals.	No action.	Very slight, evolves acetylene.	Moissan.
U_2C_3	...	...	...	...	Evolves mixture, methane, acetylene, and hydrogen.	Moissan.
ZrC	...	...	...	No action.	No action.	Kohn.

$$3\,CeC_2 + 6\,H_2O = 3\,Ce(OH)_2 + CH_4 + C_2H_2;$$

whilst thorium and uranium carbides yield, in addition, some hydrogen.

Moissan has suggested that the natural hydrocarbon oils and gases evolved from the earth may owe their origin to the decomposition of carbides, which have been formed ages ago at high temperatures under the earth's crust, by water which has found its way down to them.

The carbides of boron, chromium, silicon, zirconium, Titanium and molybdenum, are almost as indifferent to oxidation by water as carbon itself.

It may be seen from the above that this branch of chemistry, depending in many ways as it does upon electrical energy for its existence, must grow to become of great interest to the electrical engineer.

LONDON COUNTY COUNCIL.

At a meeting of the London County Council on Tuesday the Finance Committee reported that the Hampstead Vestry had applied for sanction to borrow £96,376 for electric lighting purposes, £55,461 being for engineering works, and £40,915 for buildings. The Committee was advised that £38,134 might be sanctioned for buildings. The difference of £2,781 arose mainly from a deduction of £2,350, which the Council's architect had found it necessary to make from the sum of £6,000 included for foundations, and as the information supplied by the Vestry was not sufficient to justify a larger sum being recommended. The remainder of the difference was accounted for by some small sums which should be charged to maintenance. The Committee stated that the architect experienced great difficulty in obtaining the necessary particulars from the Vestry's officials, and the discrepancy in the figures might be, and the delay which had

occurred in the grant of the sanction was due to that action on the part of the Vestry.

As to the engineering plant the Committee mentioned that £52,606 might be sanctioned for 42 years for electric lighting, and £218 for 15 years in respect of street lighting works. The sum asked for under that head was reduced by some small amounts properly chargeable to maintenance, by £720 in respect of fixing boilers already included in building works and by an amount of £1,900 included for "provision money" which might be considered later when details could be supplied by the Vestry. The Committee accordingly recommended the Council to sanction £90,740 for a period of 42 years, and £218 for 15 years.

Wireless Telegraphy for the Fire Brigade.

The report of the Fire Brigade Committee referred to the large expense which would be necessary in order to connect the fire alarm and telephone apparatus in the street station at Streatham Green with the temporary fire-station in Mitcham Lane, Streatham. Under the circumstances, the chief officer of the Brigade had suggested that a trial should be made of the Marconi system, and he had been in communication with the Wireless Telegraph Company on the subject. The company had agreed to instal and maintain the necessary instruments for a period of two years in consideration of an annual payment of £50; the instruments to remain the property of the company, and the poles to be erected by the Council.

It was pointed out by the Committee that the proposed arrangement would be less expensive than the laying of underground pipes estimated by the Post Office authorities at £280, and that the experiment would afford an opportunity of ascertaining whether wireless telegraphy could be further adopted for use by the brigade. As a consequence, the Committee recommended the acceptance of the company's offer.

The Telephone Position.

It was stated by the Highways Committee that their attention had been called to the letter recently addressed to each member of the Council by the general manager of the National Telephone Company in relation to the company's underground works. Having regard to the litigation pending between the Council and the company, the Committee did not consider it desirable to make any comment in reference to the statements contained in the letter.

Alteration of Pressure in the City.

The Highways Committee announced that the City of London Electric Lighting Company had applied for the consent of the Council to an alteration of its standard pressure of supply under the Southwark Electric Lighting Order, 1891, of from 100 volts to 200 volts. There was no reason why the desired permission should not be given, but the Committee had come to the conclusion that the conditions should be more stringent than those imposed in the case of the Westminster Electric Supply Corporation in August of last year. The Committee therefore recommended that consent should be granted subject to the following conditions:—

1. That when an installation in any consumer's premises is to be changed to the higher pressure, the undertakers shall themselves carry out, or bear the cost of, any alterations which may be necessary in the wiring or the fittings of such premises, and shall at their own cost execute any repairs and make good any damage or injury to such premises which may be rendered necessary, or caused by, the carrying out of such alterations. Provided that, if any dispute shall arise between the undertakers and any consumer as to what alterations or repairs may be necessary or what damage or injury to such premises has been caused as aforesaid, such dispute shall be decided by an arbitrator to be agreed on between the undertakers and the consumer or, failing agreement, to be appointed by the Board of Trade on the application of either party after notice to the other, and the expenses of arbitration shall be borne and paid as the arbitrator may direct.
2. That in the case of special fittings, and for lamps of small candle-power, the new lamps shall be arranged in series where so desired by the consumer.
3. That all the consumer's lamps in use and in stock shall be replaced by the undertakers, free of charge, with new lamps suitable for the higher pressure.
4. That when any such supply has been changed to the higher pressure, the consumers shall be informed, in writing, by the undertakers that all the necessary alterations have been made, and that the installation is in a satisfactory condition.
5. That when any such supply is to be changed to the higher pressure, the undertakers shall offer to the consumer to communicate with the fire insurance companies concerned, and shall take all reasonable precautions to prevent the policies being affected; and if any increase shall be made in the premium charged upon such policy, in consequence of the change to the higher pressure, the consumer shall be entitled to deduct the amount of any such increase from the payment to the undertakers for electric supply.
6. That the undertakers shall make good, at their own expense, any defects which may develop in any installation within 12 months of the date when the pressure is changed or the alteration completed (whichever may be the later date), where such defect can reasonably be attributed to the increase of pressure. Provided that if any dispute shall arise between the undertakers and any consumer as to such defects as aforesaid, such dispute shall be decided by an arbitrator to be agreed on between the undertakers and the consumer, or, failing agreement, to be appointed by the Board of Trade on the application of either party after notice to the other, and the expenses of arbitration shall be borne and paid as the arbitrator may direct.
7. That if the supply be given by a three-wire system, then subject to the approval of the Board of Trade, the middle wire shall be earthed as that Board may direct.
8. That when the supply is changed to the higher pressure on any consumer's premises, a reduction of not less than 15 per cent. shall be made in the price charged for supply at the time at which the change is so made.
9. That no increase shall be made in the price charged for supply to consumers who, under the powers conferred by the Board of Trade regulations, refuse to consent to the change in the pressure.
10. That in all cases where three wires are brought into any premises with any pressure above 220 volts between the outer wires, either one outer wire shall be removed, or the two sides shall be separated by a reasonable distance, the middle wire being split and proper fuses placed upon it, thus making two pairs of undertakers' terminals at least 6 feet apart.
11. That the undertakers, when the supply is given by an alternating system, shall, whenever called upon by a consumer, provide upon the premises of such consumer a two to one transformer.
12. That a print of the foregoing terms and conditions shall forthwith be sent by the undertakers to all their consumers.

LEGAL.

The Attorney-General *v.* National Telephone Company.

This case was before Mr. Justice Bigham and Mr. Justice Channell, sitting as a Divisional Court of Queen's Bench on Friday. Mr. Casserley and Mr. Inglejoice were with the Attorney-General, and Sir E. Clarke, Q.C., Mr. Joseph Walton, Q.C., and Mr. Roskill, appeared for the company.

The Attorney-General said their Lordships would not be troubled with the case. The information was brought to restrain the breaking up of streets by the Telephone Company without the license of the Postmaster-General. The matter was to a certain extent, he would not say complicated, but involved by the consent of the County Council being necessary, and it appeared there were certain proceedings between the County Council and the Telephone Company. Sir Edward Clarke and he agreed to this arrangement, that the hearing should stand over for three months, the defendants undertaking in the meantime not to break up the surface of any street in the County of London without obtaining the authority of the Postmaster-General and the consent of the London County Council as prescribed by the Telegraph Act, 1892, costs to be costs in the information.

Sir E. Clarke said there were some very important questions which would have had to be argued at some length before their Lordships if the case had gone on. The company made no admission or concession in agreeing to the undertaking which had been mentioned, and which he hoped would result satisfactorily to both sides.

The hearing stood over accordingly.

Turner *v.* Brinsmead.

In the Queen's Bench Division of the High Court of Justice on Saturday, the case of Turner & Son *v.* Brinsmead, which has been previously reported, was before Mr. Justice Mathew for further consideration. It was an action brought by the plaintiffs, Messrs. J. Turner & Son, of Manchester, to recover from the defendant, a builder in London, £260, the cost of an electrical lift, which the defendant said was not supplied in accordance with contract, was unworkable and had to be replaced by a lift from another manufacturer. There was also a counterclaim by the defendant for £608 beyond the amount of plaintiffs' claim. At a previous stage of the hearing of the case his Lordship suggested the advisability of his having the assistance of an electrical expert as assessor, and Prof. Kennedy was selected for that purpose. The case was last before his Lordship on March 18th, when it was suggested that the parties should come to terms. His Lordship then said that if the case was to come on again, it would be necessary to know whether it would be necessary to call Prof. Kennedy again. He had fixed his remuneration up to date at 75 guineas, to be paid equally by the parties. On Saturday it was observed by his Lordship that the plaintiffs could not claim in full for the new lift which they had had to buy. An endeavour was again made by counsel to come to an arrangement in Court, and then his Lordship suggested an adjournment to his private room. This was agreed to, and ultimately, when the parties had returned into Court, it was stated that it had been agreed that the record should be withdrawn on terms, the plaintiffs to pay the defendant £100 towards his costs, plaintiffs to have the return of the lift which they fitted, with the exception of £99 worth of work or fittings which the defendant is to keep without making any payment.

Mr. Jelf, Q.C., said he thought that was a very fair termination of a rather disastrous litigation.

Mr. Justice Mathew said he did not hesitate to say that if that case had been argued at length it would have given rise to considerable difficulties to a judge, and would have developed points of law which would have carried plaintiffs and defendant further in those Courts. The plaintiffs had been unfortunate in undertaking so serious a contract as that, but he thought they were entitled to complain, that their attention was not called earlier to what the engineers ought to have discovered to be defects in the design of the electric lift, though it was probable it would have entailed serious expense on the plaintiffs to make it an efficient affair. He was sorry that better terms could not be arranged for the plaintiffs, but he thought they had acted wisely in falling in with the suggestion that he had made. On the other hand, he thought that the defendant had met them fairly, although it had been at the eleventh hour.

BUSINESS NOTES.

Books Received.—"Electric Ship Lighting," by John W. Urquhart. Second edition. London: Crosby Lockwood and Son. 7s. 6d.

"Wireless Telegraphy and Hertzian Waves," by S. R. Bottone. London: Whittaker & Co. 3s.

Catalogues and Lists.—Messrs. Ernest Scott & Mountain, Limited, have sent us a mounted card containing particulars of their enclosed two-crank compound engines coupled to two-pole and four-pole generators. The card gives particulars of the firm's standard sizes of engines, with the output to be obtained at varying steam pressures and speeds. The same firm sends us sheets illustrating

electrically-driven hydraulic pumps, and a group of eight 60-H.P. electric motors of a special vertical type for driving centrifugal pumps on a floating pontoon dock.

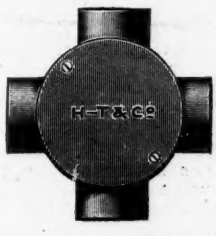
From Messrs. Mather & Platt we have received an advance copy of an excellently printed pamphlet, illustrated with some first-class pictures, of the "Reeves" patent filters for the purification of water for town supplies, and for industrial purposes. The views are taken from photographs of plant which has been installed from time to time by the Reeves' Patent Filters Company, Limited, of London, and by Messrs. Mather & Platt, who have now taken over the business of the Reeves Company.

The Sun Electrical Company, Limited, of Charing Cross Road, have issued a new list (April, 1900,) of electric light accessories. As its title indicates, there is a variety of switches, switchboards, cut-outs, plugs, ceiling roses, Sun and Cryselco lamps, wires, jointing materials, steel conduits, and other things required by those carrying out wiring and installation work. The letterpress is well arranged and fully illustrated. Prices are given.

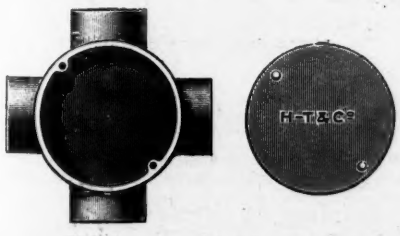
Bankruptcy Proceedings. — Under the failure of Francis Beville de Foe Paynter, electrical engineer, 2, Faversham Road, Catford, a sitting of the London Bankruptcy Court was held on the 6th inst. before Mr. Registrar Brougham for the public examination of the debtor. The receiving order was made last December in the Greenwich Court, but the proceedings were subsequently transferred to London. Accounts have been filed showing total liabilities £3,616 12s. 7d., of which £2,009 19s. are expected to rank against assets valued at £1,433 6s. 5d. The deficiency account shows that on April 1st, 1898, the debtor's assets exceeded his debts by £433 7s. 5d. That surplus has entirely disappeared, and is replaced by the present deficiency of £576 12s. 7d, the explanation being that a net loss of £200 has been made on the trading since April 1st, 1898; £510 has been expended during the same period upon household and personal necessities, and £300 has gone in exorbitant interest on borrowed moneys. The debtor commenced business in May, 1898, at 64 and 65, Chancery Lane, where he traded up to last June. Since then he has been without occupation, and he attributes his insolvency to having lived beyond his income, law costs, and exorbitant interest charges. He became aware of his insolvency about a year ago. Upon the application of the Official Receiver, the hearing was adjourned until May 18th.

Liquidations, Dissolutions, &c.—The Commercial Ozone Syndicate, Limited, is winding up voluntarily. Mr. W. W. Futcher, of W. H. Pannell & Co., Basinghall Street, E.C., is the liquidator.

Conduit Wiring.—The attention of those interested in the conduit system of wiring is invited to a new type of improved circular junction boxes now being placed on the market by Messrs.



Hayward, Tyler & Co., of Whitecross Street, E.C. The boxes, we are informed, are the result of many years' experience of wiring in iron pipe, and are made in three different sizes, viz., 3½ inches,



4½ inches and 6½ inches. The rim and cover are turned so that the box can be made perfectly watertight. The same firm are also makers of rectangular boxes, split tees, and split bends.

Doré's "London."—It were nothing short of presumption to-day to recommend the work of the brilliant Doré, whose humanity of touch has appealed to myriads of admirers. One often hears the remark passed that the countryman knows more about the sights of London than the Londoner himself, who lives and moves among them every day; but we should imagine that even the most hardened Londoner must see things in a different light after studying the representations of Doré as he went in and out among the scenes and thousand wonders of this great metropolis. His illustrations of the salient phases of London and London life by day and by night bring home to one the everyday scenes of the City man's life, features whose greatness he is apt to miss because he is so accustomed to them. In the re-issue of Doré's great work, "London: A Pilgrimage," now being brought out from the *Christian Budget* office in a couple of dozen fortnightly parts, our readers will be able to obtain the artistic productions of Gustave Doré, combined with the literary talent of Blanchard Jerrold, whose notes even in the preface, where the wanderer's programme is outlined, hold one deeply interested from first to last. The engravings are in Doré's first style, and are printed on a thick toned paper, the size of page being 12 inches × 15 inches.

Electric Boot-making.—At Wolverhampton electricity is to be utilised in the manufacture of boots. Messrs. James Baker and Sons, Limited, boot manufacturers, Cleveland Road, are at the present time putting down an electric motor for the purpose of driving a portion of the machinery used in making boots and shoes.

Electric Light and Power Stations for Vienna.—The report of the committee of experts upon the tenders for the erection of the electric generating station has been issued. The work has been entrusted to the Oesterreichischen Schuckertwerke. This firm will also receive the order for the plant for the municipal tramways which will require to begin with an aggregate of 3,000 H.P. which is to be supplied from five generating units. Another plant of 3,000 H.P. is to be erected for the generation of electricity for light and power. The buildings are to be so arranged as to allow for the erection of a further eight generating units for the tramways and four for light and power. The first power house is to be ready, at least in part, by the middle of 1901, and in complete working order by the end of 1901, and the second power house is to be ready shortly after. The undertaking is financed by the Austrian Länderbank and a loan of 30,000,000 krone (about £2,400,000) is to be raised by the municipality.

Hope-Jones Organ.—An organ on the Hope-Jones electric system has been dedicated at the Sutton (Birmingham) Parish Church.

How's Business?—We have had experience of things being "on the wear," but did not know until the other day that electrical engineering was in that way. We knew that electricity was "in its infancy," and inquired further, and finding that the headline "Electrical Engineering on the Wear" appeared in a Newcastle paper, our error became apparent. The article was one drawing attention to the large number of important electrical contracts which had been secured by the Sunderland Forge and Engineering Works, including four large engines and dynamos, &c., for the Sunderland Corporation; two 250 H.P. triple expansion engines and Pallion dynamos, together with a number of motors from 6 to 40 H.P., and a specially designed electric travelling crane for a leading shipbuilding firm in the Wear district. Other generating sets are ordered for London manufacturers, and ship lighting installations for vessels building on the Wear. A portable electric saw bench has been introduced with great success, and is being well pushed; an installation is going to the Continent to Gilsland, and so on. A special quick despatch contract was recently carried out, which comprised an installation of two engines and dynamos, with 150 lights, for a new steamer which had been chartered as a Government troopship. Special boilers have been erected at the works for testing purposes, and particularly for electrical machinery up to 1,500 H.P., and altogether the company's recently opened electrical department is doing good business.

Imports of Foreign Electrical Plant.—During March last foreign electrical material and apparatus valued at £73,085 were imported into this country as compared with only £60,780 in the preceding month. The value of such imports during the first three months of the year has reached a total of £197,018.

The Institution of Junior Engineers.—At a meeting held at Westminster Palace Hotel on Friday, April 6th, Mr. Basil H. Joy presiding, a paper was read by Mr. Eustace W. Porter on "A Comparison of Railway Bridge Structures of Moderate Dimensions and of Methods of Determining their Working Loads." At the next meeting, May 18th, a paper on "A Short Review of the Motor Car Industry, Past and Present," will be read by Mr. Charles H. Rush and Mr. Basil H. Joy.

The Jones Underfeed Mechanical Stoker.—As the result of a short notice of this stoker, the agents in this country, Messrs. Moffat & Co., of Charterhouse Square, have sent us some further papers relative to the machine, together with illustrations and figures of tests. It appears that the machine is in extended use in America and Canada, and that it depends entirely upon mechanical draught, the air inlets being along two rows only, and there being no grate but merely a dead plate surface from which we estimated that in any case despite the mechanical draught, the rate of combustion per square foot of area of "grate" surface would be low. While the tests appear satisfactory we find nothing to indicate at what rate combustion was effected. The forced draught and the very thick bed of fire are certainly steps in the right direction, and the extended use of the furnace would seem to indicate that it does give a sufficient output. In one test, indeed, we find figures given. In 8 hours 3,848 lbs. of fuel were burned on a grate of 45 feet area. This is equivalent to barely 10 lbs. of coal per square foot per hour. True, the hand-fired grate displaced had an area of 67·5 square feet and

burned 6,055 lbs. in 8 hours, and burned somewhat over 11 lbs. per square foot per hour. So far this result must be eminently satisfactory to the steam user in particular, but in English practice where, with ordinary hand-firing, we burn upwards of 20 and 25 lbs. per square foot, this form of coking stoker, however excellent in principle and in economy, could not be entertained unless it can be shown capable of coking its charge at the higher rates. There does not seem to us a sufficient reason for limiting the air inlet unless it be that the rate of coking cannot be increased beyond 10 lbs. Several tests are recorded in the pamphlets, but none afford this really vital information to enable one to come to a better conclusion. As above stated, the doubt in our mind is rather one of quantity than quality—assuming, that is, that the difficulty of compelling the green coal to rise evenly from all parts of the retort, has been effectually overcome by choice of suitable angles, and suitable arrangement of pushers and auxiliary pushers.

Lifts.—The new yacht *Victoria and Albert* now being built for the Queen, is to be fitted, by Messrs. Waygood & Co., with a passenger lift for Her Majesty's use. The lift will run from the state to the upper deck, and will be contructed upon a special principle, designed by the firm to conform to the special difficulties of the case.

Motor Car Exhibition.—The Automobile Club's Motor Car Exhibition opens at the Agricultural Hall, Islington, to-morrow, Saturday, April 14th, and continues open until the following Saturday, 21st inst. Mr. Chas. Cordingley is the business manager of the exhibition.

Municipal Fire Insurance.—The *Financial Times* says that during the past few months some of the metropolitan local authorities, and especially those which have powers under the Electric Lighting Acts, have been complaining of the annual premiums paid for the insurance against fire of the public buildings, libraries, electric lighting stations, baths and other buildings. The complaints are due not so much to the question of high premiums as to the necessity for paying large sums annually without any apparent return for the outlay, as fires in the public buildings are of extremely rare occurrence. In this connection a correspondent states that arrangements are now being made for the holding of a conference of all the London local authorities, some 40 in number, for the purpose of considering the desirability of asking the London County Council to act as the central insurance authority for the whole of the metropolitan spending authorities. In the meantime, the fact may be recalled that a few years ago the County Council appointed a special committee to investigate the subject, and much time was devoted to the preparation of statistics in order to ascertain whether it would be possible and advantageous to establish a municipal insurance society. After due consideration, however, the Council decided not to entertain the proposal, but whether the representations intended to be made by the forthcoming conference will have the effect of reopening the question is a matter for the future to determine.

New Cross.—A large new factory for the Mazawattee Tea Company is in course of erection at New Cross. The works, part of which are already in operation, are not only lighted by electricity, but all the machinery is being electrically driven. Several of the motors are located above the ground, in recesses formed in the walls, and drive the shafting by means of the special "Silent" chain made by Hans Renold, Manchester. This type of chain is beginning to come into extensive use among electrical engineers, it being now used, among others, by the India-Rubber and Gutta-Percha Company, Messrs. Crompton, Messrs. Johnson & Phillips, &c.

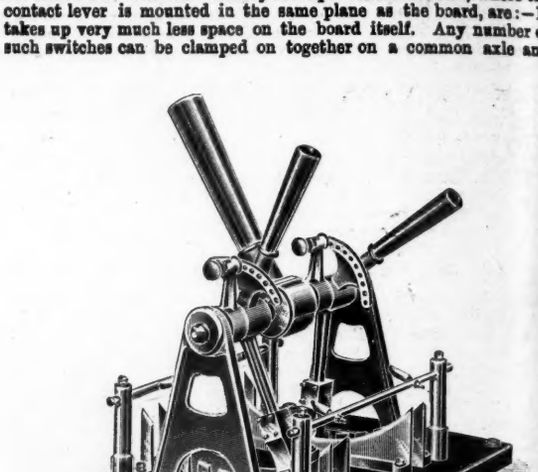
Non-magnetic Watches and Clocks.—On the City and South London Railway we understand that the non-magnetic brakesmen's watches, station and other clocks over all the system have been supplied by Mr. J. Sewill, of 30, Cornhill, E.C.

Paris Exhibition.—Messrs. S. Smith & Son, Limited, Strand, W.C., whose name is familiar to everyone as makers of non-magnetic watches, have despatched a valuable exhibit to Paris. It consists of watches and clocks to the value of about £15,000, of a very high class of manufacture. There are about 100 watches, the average value being from £70 to £80, and about 20 clocks, the majority being non-magnetic. Messrs. Smith are endeavouring by their exhibit to show, and we believe they will succeed, that a very high standard exists in English manufacture compared with Continental makes.

The Siemens Companies.—The *Financial Times* says that a general meeting of the German Siemens & Halske Company has been convened for the 19th inst. in Berlin, when a proposal will be made to increase the share capital from 45,000,000 marks to 54,500,000 marks by the issue of 9,500 new shares of 1,000 marks. Of this number 4,500 shares will be offered at the rate of 155 per cent. to existing shareholders, whilst the remaining 5,000 will be issued to members of the Siemens family in return for the transfer of shares to the extent of £200,000 in the English concern of Siemens Bros. & Co., Limited, and of shares to the value of 2,000,000 roubles in the Russian Siemens & Halske Company in St. Petersburg. By this means the German company will secure a direct interest both in the Russian and English concerns, whereas it has hitherto only been possible to obtain the co-operation of those undertakings by reason of the personal holdings of the members of the Siemens family.

Society of Model Engineers.—At the monthly meeting on April 3rd, Mr. James O. Crebbin read a paper on "Model Boilers." The lecture was illustrated throughout with lantern slides, and was principally devoted to consideration of boilers for model locomotives.

Patent Switch Gear.—We illustrate below a patent switch gear (Lucas's patent) which has just been brought out by the Edison & Swan Company. The chief points of advantage claimed for this switch over the ordinary multiple contact switch, where the contact lever is mounted in the same plane as the board, are:—It takes up very much less space on the board itself. Any number of such switches can be clamped on together on a common axle and



worked simultaneously or independently, or in any relative position of one to the other. In order to obtain a very large number of contacts, especially where a large current is required, the contacts of two or more switches can be so arranged and clamped up to the main axle that each one makes contact slightly after the other, thus giving any number of contacts contained in a small space with a large range of adjustment, and, generally, that the switch can easily be adapted to an ordinary charge and discharge switch for accumulators, or for almost any form of resistance up to any quantity of current, and from the disposition of the contacts and the distance the handle is from the current-carrying parts, it is equally suitable for high tension as for low.

Trade Announcements.—The Central London Railway Company have removed their general offices to 125, High Holborn, W.C.

Messrs. Barnett & Co., electrical engineers and contractors, late of 30, Kingsland Road, Shoreditch, have removed to 79, Camomile Street Chambers, Bishopsgate.

Westralian Electrical Trade.—From an advertisement in this issue it will be seen that Messrs. Splatt, Wall & Co., of Perth, Western Australia, are open to represent electrical firms in that part of the world. Mr. Wall is now on a visit to England.

Workmen's Compensation.—At Leeds County Court on 6th inst. a labourer claimed 10s. a week compensation from Messrs. Cuttriss, Wallis & Co., electricians, in respect of the loss of an arm which was caught in some machinery and torn out. There was no opposition from defendants, but it was stated that the company was in voluntary liquidation. An award was made on the basis of the claim.

A Scotch Court has granted a labourer compensation amounting to 10s. weekly while incapacitated, because he, while in the employ of the National Conduit and Cable Company of Glasgow, was injured about 10 or 11 days after he had entered their employment—while holding a wedge which another labourer was hammering. The hammerer seems to have mistaken the man's hand for the wedge and treated it accordingly. It was not easy to decide what were the "average weekly earnings," on account of the brief period of his employment.

ELECTRIC LIGHT AND POWER NOTES.

Aberdeen.—The Council has agreed to acquire the property known as Dee Village, and situated between Crown Street and Wellington Road, for the purpose of erecting upon it a new electric station at a cost of £8,000.

Alfreton.—The District Council has sealed an agreement with Mr. J. S. Barnes, who has been appointed electrical engineer for carrying out a scheme of electric lighting in the district. The cost of the undertaking is estimated at £12,000.

Barking.—An electrical exhibition was opened on Friday last at the public offices, Barking, with a view to popularising the electricity supply business. The exhibition included a large variety

of electric light fittings, heating, cooking, and medical appliances, ventilating fans, and electric motors, showing their applications. Mr. S. E. Britten, the resident electrical engineer, read a statement at the opening ceremony as to the objects of the exhibition and its special features. The exhibition, which was opened by the chairman of the Council, Mr. J. N. Reeson, remained open until Wednesday, and we have no doubt will lead to a marked increase in the demand for electricity.

Brighton.—The Lighting Committee reported to the Council last week that it had received letters from Mr. Arthur Wright, the electrical engineer,

suggesting the appointment of Mr. Joyce as acting manager during Mr. Fowler's absence, and an alteration in the terms of his own engagement. Mr. Wright stated that while being very willing to continue to take full responsibility under the Lighting Committee for the proper carrying on of the electric lighting undertaking, he now felt that it was hardly necessary, or even possible, for him to continue to be nominally responsible for all the ordinary routine work of the business, as the heads of the different departments were now perfectly able with the help of the acting manager, to carry out this every-day routine work. On all important commercial questions, and in cases of serious difficulties, he would, of course, prefer to be consulted, as the continued success of the Brighton electricity undertaking would always be his first consideration. He therefore proposed that the terms of his appointment be redrawn, so that he should, in future, be the consulting manager and engineer, whose duty it would be to superintend the design of new extensions, advise the Lighting Committee on commercial and technical developments, and arrange, through the acting manager, the organisation of the staff for the proper carrying on of the supply business. Should he at any time have to be absent from England, he would undertake to appoint a duly qualified electrical and civil engineer to act for him in case of emergency. As an earnest of his desire to continue to superintend and be mainly responsible for the carrying on of the Brighton electric lighting, with which he had been connected for the last 19 years, he was willing to enter into an agreement, should the Council desire it, to act as consultant for a minimum period of five years at an annual fee equivalent to his present salary, and subject to the Corporation being able to determine such an agreement by three months' notice, if thought desirable. Under this new arrangement he would be willing to pay his travelling expenses, and thought the result of his wider experience in other towns would be of material service to the Brighton Corporation. As he had at present no intention of moving his residence from Brighton, and certainly not his chief interest in its electrical welfare, he felt the only real effect of his proposal on the Corporation's electricity undertaking would be to develop a greater sense of self-reliance and responsibility in the acting manager and other members of the staff without in any way endangering the continued success of the electricity works. The Committee adopted Mr. Wright's suggestions, and recommended that Mr. Wright should be retained as consulting engineer to the electricity undertaking at his present salary (£600 per annum), provided he entered into an agreement in a form to be approved by the town clerk, binding himself to remain in the service of the Corporation for a period of five years, the Corporation, on their part, to be at liberty to terminate the engagement on three months' notice. The Committee also recommended that Mr. Joyce should be appointed acting manager *pro tem.*

The discussion which followed was very lengthy, and those who are anxious to see it will find it in the *Sussex Daily News* of April 6th. Many things were said which were unfavourable to Mr. Wright, and that this was so may be gathered from the result of the debate, for the report was rejected by a majority of 2, the voting being 19 for its acceptance and 21 against.

Bristol.—The following figures—which were given in support of Alderman Pearson's contention at the recent Local Government inquiry that the Local Government Board gives more favourable terms for repayment of capital to other municipal electrical undertakings than to Bristol—are not without interest:—

	Loans on Dec. 31st, 1898, or Mar. 31st, 1899.	Repayment in the year.	Rate of repayment per cent.	Remarks.
SCOTLAND.	£	£	£ s. d.	
Glasgow	332,000	8,220	1 0 0	Annual Repayment.
Edinburgh	366,570	9,566	2 12 2	
*METROPOLITAN VESTRIES.				
Hammersmith ..	66,661	959	1 8 9	
Hampstead	126,570	1,197	0 18 9	
Islington	191,900	1,962	1 4 0	
Shoreditch	71,032	834	1 3 5	Sinking Fund.
St. Pancras	184,930	2,940	1 11 9	
*ENGLISH PROVINCIAL TOWNS.				
Liverpool	556,000	8,890	1 12 0	Sinking Fund.
Bradford	160,786	4,780	2 18 9	" "
Nottingham	123,710	1,620	1 6 0	
Salford	81,100	1,429	1 15 2	Sinking Fund.
Leicester	77,207	2,186	2 14 9	" "
†OTHER PROVINCIAL TOWNS.				
Manchester	395,602	10,377	2 12 5	Sinking Fund.
Huddersfield ..	88,815	1,897	2 2 9	" "
Portsmouth	129,651	3,610	2 15 9	" "
Cardiff	31,614	844	2 13 5	" "
Bristol	189,768	6,400	3 7 5	Annual Repayment.

* These figures are compiled from Mr. Emile Garcke's manuals.
† These figures are compiled from the annual accounts of the towns.

Colne.—The Town Council has instructed the electrical engineer to prepare estimates for an electric generating station.

Farnworth.—Colonel Marsh, R.E., Local Government Board Inspector, conducted an inquiry last week into an application by the District Council for authority to borrow £22,000 for building and equipping a new electricity generating station on some freehold land belonging to the Council, for lighting purposes, public and private, and for supplying power for tramcars through the central portions of the town. There was no opposition.

Germany.—A central electric lighting station is about to be established at Ederaleben for the supply of current to a number of small towns in the district.

Grantham.—The Board of Trade has approved of the provisional order of the Town Council in regard to electric lighting.

Guildford.—The Electric Lighting Company has prospered during the past year; the deficit of £223 has been wiped off, interest paid on loans, and a sum set aside for depreciation. The output was nearly doubled during the year.

Halesowen.—The Urban District Council has decided to transfer its electric lighting order to the Midland Electric Corporation, Limited.

Hornsey.—The Parish of Hornsey is among the most important suburbs of the metropolis. The population, which was 44,205 in 1891, must now exceed that number by at least another 10,000, and the rateable value approaches half a million. It is governed by an Urban District Council, evidently possessing the entire confidence of the ratepayers, for a recent meeting of owners and ratepayers, *called by the local authority*, to consider a most important question affecting the interests of the district was attended, according to the report of the Hornsey journal of March 31st, by *two ratepayers* exclusive of members of the Council. The matter submitted to the meeting was the consideration of the following resolution, viz.:—

That, it being in the judgment of the Urban District Council of Hornsey expedient that the Bill now being promoted in Parliament for incorporating and conferring powers upon the North Metropolitan Electric Power Supply Company, and for other purposes, intended, if passed, to be cited as "The North Metropolitan Electric Power Supply Company Act, 1900," should be opposed, the Council do accordingly take all the necessary steps to oppose such Bill in Parliament, and to apply the general district rate levied by the Council to the payment of the costs and expenses attending such opposition.

The resolution was carried unanimously by the two ratepayers—who were told by the chairman that this company [that is to say the company to be formed for supply of electricity *in bulk* ("*wholesale*") when the present Bill becomes law] gave the Council notice last June of an intention to apply for a provisional order, evidently confusing a company *in esse* with another *in posse*. The chairman added that—

If they had had no idea of providing the electricity themselves, the Council would not wish to put obstacles in the way of any company.

This is somewhat obscure, but probably he meant that if the company did not intend to supply *retail*, there would be no ground of opposition, but the Bill he opposes is solely for the purpose of supplying *wholesale in bulk* to authorised undertakers under provisional orders or statutory powers. Then the chairman goes on to say that the company would not have to go across Hornsey to serve other districts. The opposition to the Bill is therefore most puzzling to those who desire to promote a supply of electricity everywhere on the most favourable terms. Here is a Bill under which the local authorities who possess a provisional order—or any company to which they may transfer it—*have an option* (for it is purely a *permissive* Bill) of having their electricity generated at a distance, if it can be done on better terms than on the spot. The inhabitants of Hornsey differ from others, if they would not prefer the steam power, shafts, &c., being removed from their own doors. But Mr. Burt made "confusion worse confounded" by stating that the object of the Bill was to over-ride the Electric Lighting Act, and prevent the Council from purchasing the company's plant at any time, adding that he was glad to say that the districts through which they would have to pass to get to Hornsey were opposing the Bill. This Electrical Power Bill is really intended to give practical effect to the recommendations of the Joint Committee of the House of Lords and the House of Commons, who reported as follows:—

Where sufficient public advantage is shown, powers may be given for the supply of electrical energy over an area including districts of numerous local authorities, and involving plant of exceptional dimensions and high voltage. The Committee further think that undertakings of this character may properly be authorised on conditions differing in some respects from those imposed by and under the existing Acts.

Among the undertakers referred to in the preceding paragraph will be found undertakers supplying energy chiefly in bulk or wholesale to other undertakers, whether local authorities or companies, whose areas of supply are wholly or partly within the area of such bulk or wholesale supplying company, and who distribute the energy so obtained to consumers.

But, in spite of Lords and Commons, the Hornsey Urban District Council and their two supporters decide upon opposition, at the ratepayers' expense, and try, like Mrs. Partington with her broom, to stem the tide of progress. Well may the Americans say, as quoted by us last week:—

If England allows this kind of thwarting to stand in the way of her progress, she will not merely have to take sound thrashings from the Boers until she overmasters them, but she will have to take worse punishment from more powerful foes.

Kilmarnock.—The Town Council has resolved to carry out an electricity supply scheme, estimated to cost £25,000. Mr. Bryson, of Leith, has been appointed consulting electrical engineer to the Corporation.

London.—COURT OF COMMON COUNCIL.—The Council has decided not to oppose the City of London Electric Lighting Company's Bill in Parliament if a clause is inserted giving the Corporation power to purchase the whole of the company's undertaking on suitable terms.

ST. GEORGE'S VESTRY.—The General Purposes Committee reported that they had at their last meeting under consideration letters from the County of London and Brush Provincial Electric Lighting Company, with regard to the refusal of the Vestry to permit them to lay down mains in Montague Street, on the ground that it had been reported that the company were supplying premises in the parish with electrical energy from other than their own generating stations. The company stated that the report was inaccurate, and the surveyor had ascertained that the supply was being given from one of the company's sub-stations in Peckham. As the matter was one which affected the general interests of the whole of the parish, and as

several ratepayers were desirous of obtaining a supply in the immediate neighbourhood of Montague Street, the Committee had instructed the Vestry clerk to inform the company that no further opposition would be offered to the proposal to lay mains in the streets. After a long discussion the following resolution was adopted:—"That the recommendation of the Works Committee adopted by the Vestry at their last meeting be rescinded, and that the plans of the County of London and Brush Provincial Electric Lighting Company to lay down electric conduits in Montague Street be approved."

Poplar.—The managers of the Poplar and Stepney Sick Asylum have decided to light the asylum with electricity.

Hammersmith.—The Vestry has received the formal consent of the London County Council to the borrowing of the sum of £44,548, the amount required for purposes connected with the electric lighting undertaking.

East London.—On the 6th inst. the Vestries of St. George-in-the-East, Limehouse, and Mile End Old Town came before the Board of Trade to have their electric lighting provisional orders confirmed. They were opposed by the County of London and Brush Provincial Electric Lighting Company, who already have an order for supplying electricity in those Vestries' districts, but have not begun to do so. The three Vestries argued that in November next they would be joined with Whitechapel, which had an electric supply order, and would form the new borough of Stepney, and that this private company should not be allowed to compete. Sir Courtenay Boyle, who heard the parties, reserved his decision on the preamble, and said that, supposing the orders were granted, they should all conform to the provisions of Whitechapel, in order that under the London Government Act, the new municipality of Stepney should have identical provisions over the whole borough. The decision on the preamble would be communicated to the parties as soon as possible.

Court of Common Council.—Last week, according to the *City Press*, the Streets Committee recommended that the electrical engineer should confer with the promoters of the City of London Electric Lighting Company's Bill with a view to obtaining the insertion of a clause giving power to the Corporation to purchase the whole of the company's undertaking outside the City on the same terms and at the same periods as are stated in the City of London Electric Lighting Orders, 1890 and 1891, and the Electric Lighting Acts, with regard to the portion of the undertaking within the City. The Committee also recommended that, in the event of a suitable clause being inserted in the Bill, the opposition of the Corporation thereto should be withdrawn. The same Committee recommended that the Remembrancer should be instructed to lodge a petition against proposed alterations in the Bill of the Charing Cross and Strand Electricity Supply Corporation. The Court approved.

Newark.—The Board of Trade has granted a provisional order to the Corporation of Newark to supply electricity within the borough, and to expend for that purpose £20,000.

Newburn.—The District Council has decided to support the Tyneside Electric Power Bill by resolution and by giving evidence in its favour.

Newcastle.—The City Council has adopted the recommendation of the Watch Committee to apply to the Local Government Board for leave to borrow £10,000 for the purpose of electric lighting of certain streets. About 180 arc lamps will be required, costing at £18 per lamp, £3,240 per annum. This is about double the cost of the lighting at present provided by gas and electricity.

Salford.—At a meeting of the Salford Town Council last week the proceedings of the Electric Light Committee came under discussion.

Mr. Stephens began the debate by inquiring the reason why Mr. Haworth had tendered his resignation as chairman of the Committee.

The Mayor suggested that, as the matter was one of importance and involved a question that required investigation, it might be well to wait for a report of the Committee, and then to take action.

Mr. Haworth (chairman of the Committee) suggested the appointment of a special committee to report on the matter.

After a good deal of discussion it was decided to suspend the standing orders. The following letter from Mr. Haworth was then read: "I am going away on Monday, and wish to place my resignation as chairman of the Electric Light Committee in the hands of the Committee. I find I cannot give the time to and bear the strain of the present work. I hope there will be a satisfactory result to the visit to Wednesbury on Thursday next." Mr. Haworth, after the reading of the letter, said the whole matter was a very painful one to him. He proceeded to explain that three weeks ago he was informed there were alleged to be certain irregularities in connection with a contract under the Electric Light Committee. He gave an account of them, and said that he afterwards saw one of their officials at the Town Hall and inquired into the matter. His inquiry satisfied him that the position was such that the Council ought to take severe measures on the question.

There followed a long and rather exciting debate. Mr. George Jones urged that there was no proof of any wrong act in regard to the matter of procedure, so far as that procedure was known. He asked the Council to leave the matter to the Committee, who, although much divided, would report in due course. Action could then be taken.

The Council in the end appointed a special committee to consider the matter and report.

Shoreditch.—At the last Vestry meeting the Finance Committee reported that the application for sanction to the borrowing of a sum of £96,000, repayable within 42 years, in respect of the cost of erecting and equipping the Haggerston electric light station, has been dealt with by the London County Council to the following extent:—Works: Building works, £32,095 amount applied for, £28,000 amount now sanctioned; engineering works, £63,905 amount applied for, £42,000 sanctioned; totals, £96,000 amount applied for, £70,000 amount now sanctioned. The Committee therefore recommended that application be made to the London County Council to advance the money by a first instalment of £20,000, to be followed by further advances of £10,000, as the work proceeds, at a rate of interest not exceeding 3½ per cent. This was agreed to.

Swindon.—Messrs. Lacey, Clirehugh & Sillar have presented their report on a combined lighting and tramway scheme.

Warrington.—The Town Council has agreed to withdraw its opposition to the Lancashire Electric Power Bill as amended after the second reading.

Wolverhampton.—The Corporation is advertising for tenders for the supply of 5,000 tons of good steam coal during the year 1900 to April 30th, 1901, for the electricity works.

ELECTRIC TRACTION NOTES.

Batley.—The Board of Trade has issued an order sanctioning the Batley Corporation's application for leave to construct tramways throughout the borough. This announcement, says the *Bradford Observer*, will be read with great astonishment by the officials and members of the local authorities in the Heavy Woollen district and Spen Valley who have passed resolutions in favour of the British Electric Traction Company's scheme in preference to that of the Batley Corporation, in the expectation that a local inquiry would be conducted by the Light Railways Commissioners at an early date. It is usual for applications of this character to be submitted to the Light Railways Commissioners, and the application of the British Electric Traction Company to construct tramways in Dewsbury, Ravensthorpe, Heckmondwike, Gomersal, Liversedge, Cleckheaton, Thornhill and a small part of Batley is to be the subject of an inquiry at Leeds. The Town Council of Batley, however, appealed direct to the Board of Trade, unknown, it is believed, to the other local authorities.

Birmingham.—A second proposal to use the overhead trolley system in Birmingham comes from the Birmingham and Midland Tramways Company, in which the British Electric Traction Company have acquired a large interest. The line upon which the change from steam to trolley is wanted runs from Lionel Street Parade, along Dudley Road, to the city boundary at Winson Green. There is about 6½ years' lease to run. The matter came before the Tramways Sub-Committee on Tuesday. We trust that for the good of electric traction and for the good of the multitudes of travelling public at Birmingham, that the opposition to the trolley system, which has been materially weakened of recent days by the success of overhead wire trams in other large towns, will go into rapid decline and allow useful progress to be made, whoever makes it, whether company or municipality. Alas! it is only too true that London and Birmingham have sailed in the same boat for the past few years by fostering a quibbling dislike to what has succeeded in scores of other places. What have they achieved? They have hampered tramway companies, and have prevented the public from enjoying those rapid and convenient means of travel which should have been available to the Londoner five years ago, when the Bristol Company started its lines. Nothing else has been achieved, unless it be that English manufacturers will be in a better position to fulfil the power plant and outside equipment contracts than they were in 1895.

King's Norton District Council has unanimously approved of overhead traction for the Bristol Road only.

Bootle.—The Liverpool Corporation has informed the Bootle Corporation that the Stanley Road extension of the electric car service would be commenced as soon as possible.

Brighton.—Volk's electric railway, which has been reconstructed, is now open. The cars ran on the new lines right through to the Aquarium station for the first time on Sunday.

Dudley and Sedgley.—Our Wolverhampton correspondent writes:—"Grave complaints are being made in the Sedgley district at the extremely slow progress made by the British Electric Traction Company with the reconstruction of the tramways between Upper Gornal and Dudley. Much inconvenience is experienced owing to the traffic between the two districts having been suspended for nearly three months."

Newport (Mon.)—The Electricity Committee decided that the overhead span-wire system was the most suitable for the tramways, but the Corporation referred back their recommendation with a request that inquiries should be made as to the new surface contact system adopted at Tours, Monaco, and Paris. At the last meeting of the Committee the borough engineer reported on the matter, dealing more particularly with the surface contact systems adopted at Tours, Monaco, and Paris. The Committee resolved that, having regard to the opinion of Mr. Parshall and the report of the borough engineer, they are strongly of opinion that the span-wire system is the best, and they adhere to their recommendation in favour of its adoption.

(*Continued on page* 623.)

YORK CORPORATION ELECTRICITY WORKS.

The history of electric lighting in York is a record of futile efforts comparable with those of Sisyphus, and irresistibly recalls the time-worn quatrain:—

> Oh, the noble Duke of York!
> He had ten thousand men;
> He led them up to the top of the hill,
> And led them down again!!

If the quotation is inaccurate, our memory is to blame.

In brief, the story runs as follows:—

July, 1889.—Five companies notified their intention to apply for orders.

November, 1889.—The Council resolved to apply, and Mr. Shoolbred was appointed consulting engineer.

August, 1890.—The Board of Trade granted the Council's application, and allowed *two years* for carrying out the work.

September, 1890.—Sub-committee appointed.

June, 1891.—Committee appointed.

July, 1891.—Sub-committee visited other towns.

May, 1892.—Sub-committee reported. Resolved, to borrow £15,000 and erect electricity works; Mr. Crompton appointed consulting engineer.

October, 1892.—Tenders invited to Mr. Crompton's specifications; Mr. Crompton resigned.

January, 1893.—Prof. Kennedy appointed consulting engineer.

June, 1893.—Sub-committee recommended Messrs. Siemens Bros.' tender for acceptance.

December, 1894.—Committee recommended the Electric Construction Company's tender (high tension direct current).

April, 1895.—Committee's report sent back by Council.

May, 1895.—Low tension system decided upon.

August, 1895.—Fresh start. Mr. Preece asked to draw up a report.

September, 1895.—Board of Trade threatened revocation of order.

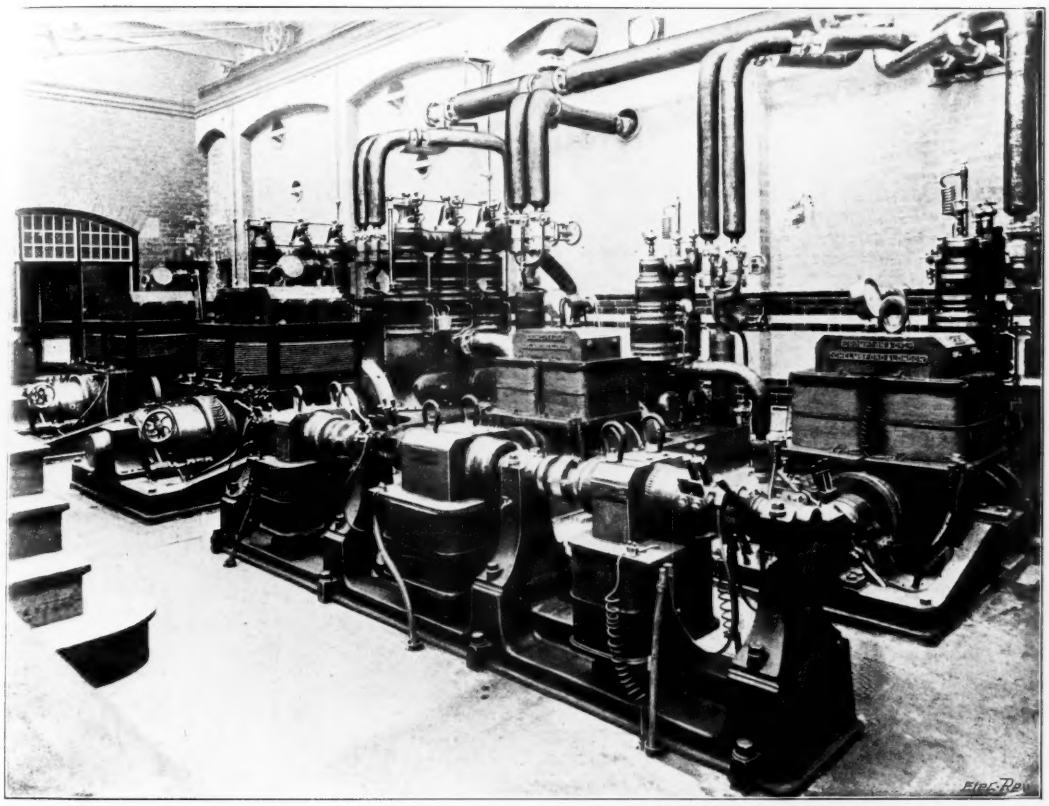
November, 1895.—Mr. Preece having declined, Prof. Kennedy appointed to report.

April, 1896.—Report discussed; specifications put in hand.

February, 1897.—Prof. Kennedy's scheme adopted and tenders provisionally accepted.

June, 1897.—Special committee appointed.

October, 1897.—Committee's recommendation to borrow £20,000 and to carry out Prof. Kennedy's scheme adopted.



General View of Engine Room.

June, 1898.—Loan sanctioned; Messrs. Crompton's tender accepted for the whole installation—£8,654. Messrs. Parker & Sharp contractors for buildings, £7,174 12s. 4d.

July, 1899.—Mr. C. A. Midgley appointed city electrical engineer.

April, 1900.—Supply of electricity commenced.

It may be added that during these prolonged deliberations the systems "adopted" include high tension, both direct and alternating, and low tension direct. Fortunately, only one of these has been carried out—the low tension direct current system—and that is, beyond doubt, the most suitable for the existing conditions.

The installation, as it exists at present, is capable of supplying a lamp connection equivalent to 10,000 8-c.p. lamps. It is housed in well-arranged, but somewhat cramped, buildings on a site at Foss Islands, about a mile from the centre of the area supplied. The bat-

tery room, engine room, and boiler house are placed side by side in the order named, with economiser and chimney shaft beyond. The shaft is 180 feet high and 7 feet 6 inches diameter at the top, and is intended to provide both for the electricity works and for a refuse destructor, which is being built close by; it is suggested that the destructor boilers shall in part assist the electricity works, but we have seen enough of destructors to hope, in the interests of the former, that the threat will not be carried into effect. Offices and stores are in course of completion in connection with the main buildings, and a railway siding is to be constructed, running from the coal store behind the boilers to a branch of the North-Eastern Railway close by.

The boilers, of which two are at present installed, are of the Lancashire type, 28 feet long by 8 feet diameter, working at a pressure of 125 lbs. per square inch, and were made by Messrs. R. Taylor & Sons, Marsden; the boiler fittings are of Messrs. Hopkinson's make. The coal used is what is known as Silkstone peanuts, and seems to be of fairly good quality. The economiser, of Messrs. Green's well-known type, consists of 192 tubes; the scrapers are driven by a Crompton motor of 1½ B.H.P., and the whole is housed in a separate building.

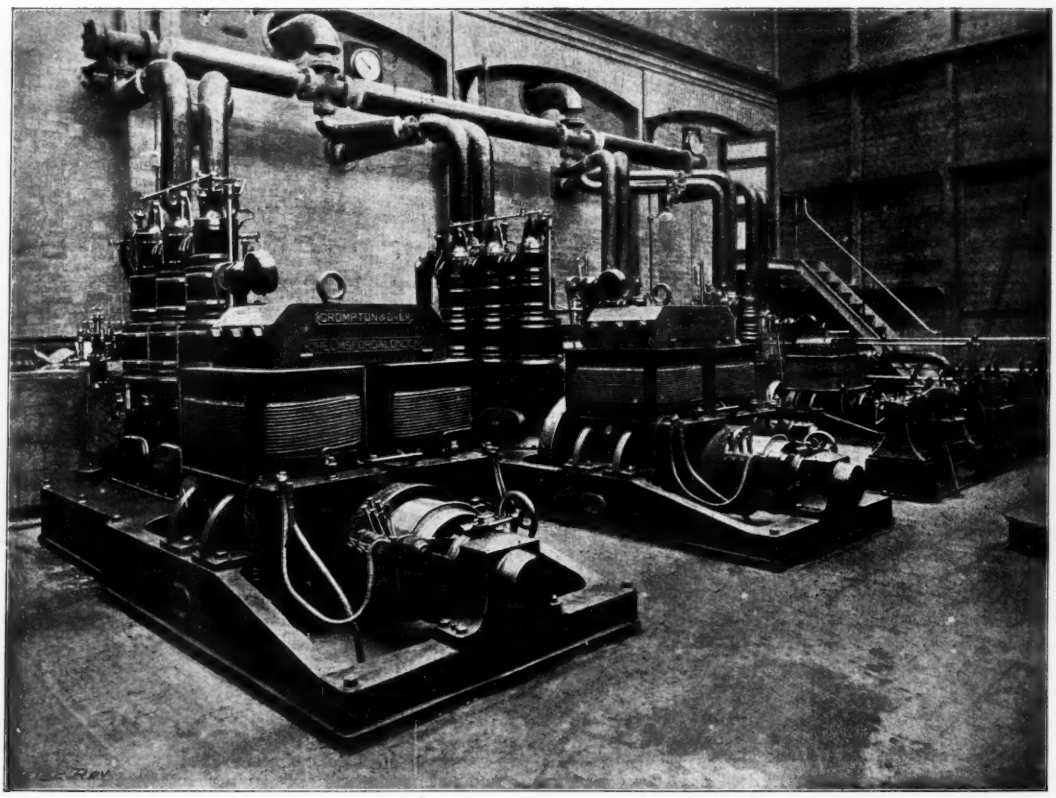
The steam piping, of mild steel, is in duplicate from the boilers to the engines; there is no ring main, two separate main pipes being carried one on either side of the division wall between the engine room and boiler house. The pipes are lagged with Haacke fossil meal composition.

The feed pumps are two in number, of the three-throw plunger type, supplied by Messrs. Warner & Co., Walton-on-the-Naze; they are driven through Hollick friction gear by Crompton motors. The friction gear, which was described in our issue of November 17th, 1899, consists of a short link belt embracing two "flat"-faced pulleys, between which a small friction pulley, fixed on the motor shaft, is gripped by means of a lever and rocking frame. The motors are provided with controlling gear, by means of which they may be run at 900 revolutions per minute off the 460-volt mains, giving 3·65 B H.P. each: at 450 revolutions per minute off the 230-volt mains, giving 1·75 B.H P.: or at 180 revolutions per minute, with resistance in series, giving 0 75 B H P.

Water supply is available from the town mains, and from the River Foss; the former is passed through a Kennedy water meter into a small tank over the feed pumps, of 2,500 gallons capacity. The feed pipes are, of course, in duplicate throughout.

The engines are provided with exhaust to atmosphere, but are normally connected with a jet condenser capable of condensing 25,000 lbs. of steam per hour, with a vacuum of 26 inches of mercury. The condenser, of which we give a view, is situated in a chamber below the level of the engine room floor. As the ground is of a very wet nature, the walls and floor of this chamber, as well as of all low-lying parts of the station, are lined with Callender waterproof bitumen sheeting.

The air-pump consists of a cross-compound steam engine acting direct upon a twin-cylinder pump, the two lines being connected by a rocking bar. The steam cylinders are 12 and 20 inches in diameter, the pump barrels 25 inches diameter, and the stroke 18 inches. Condensing water is obtained from the River Foss. The whole of the condensing plant was supplied by the Worthington Company.



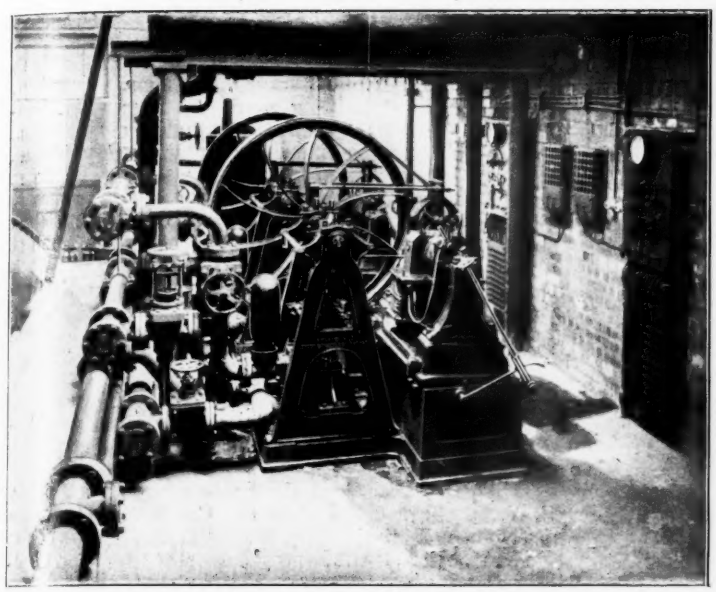
[Main Generating Sets.

The engine room is served by a travelling crane made by Messrs. Carrick & Ritchie, having a span of 31 feet, and capable of lifting 8 tons; the crane is operated from the floor, and is provided with a quick lift for loads up to 1 ton.

The generating plant consists of two 75-KW. and two 24-KW. Crompton-Willans steam dynamos. The former run at 460 volts and upwards, at 460 revolutions per minute, the engine being of the three-crank type, size GGGS; the dynamos are designed with a view to future tramway supply, and are capable of working up to 560 volts, when excited by the shunt winding at no load, while series coils are provided, but are, of course, not in use at present. The most striking feature about the construction of the machines, which are well seen in one of our views, was the large diameter of the commutators — nearly as large as the armatures! The latter appeared to have end connections of the "barrel" type, an unusual design for two-pole dynamos; this permits of ventilating passages right through both armature core and commutator. The field-magnet windings also are of interest, the bobbins being of very substantial construction and the coils being coned

at the ends, with consequent gain of cooling surface. The bearings are of the swivel type, with automatic ring lubrication.

The smaller dynamos are rated at 24 KW. each, at 230 volts, and are driven at 520 revolutions per minute by two-crank engines of size EE; these are used as balancers,



Electrically-Driven Feed Pumps.

but 460-volt spare armatures are provided, by means of which they can be run on the outers of the three-wire system. A spare armature is also held in reserve for the larger machines. All the generators have been proved capable of withstanding a prolonged overload of 15 per cent. without overheating or sparking. For charging the batteries two boosters are provided, driven by a 460-volt motor, and capable of boosting a current of 50 amperes normally, or 100 amperes in case of need, from 0 to 70 volts. We have seen boosters which could not be used for less than 20 volts of boost; this defect, which, we have been informed, is in at least some instances due chiefly to magnetic leakage from the motor combined with residual magnetism in the booster fields, is totally absent from the machines above mentioned.

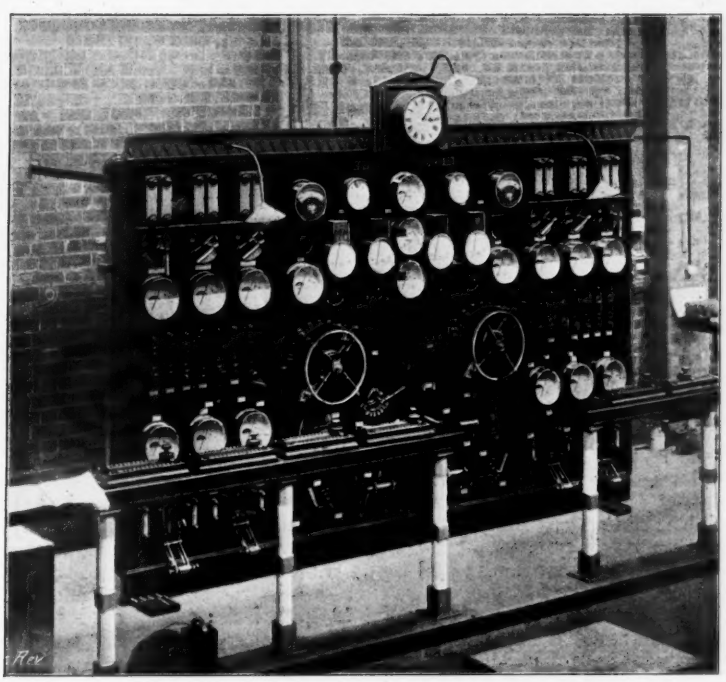
The switchboard, as seen in our view, consists of five panels of enamelled slate carried in a cast-iron frame, and provides for three feeders, four dynamos, the booster set and two batteries. The feeders are protected by duplex fuses, beneath which plates are fixed to prevent fused metal from falling on the switch gear below; a 500-ampere Kelvin gauge is in circuit with each feeder.

There are seven vertical bars for feeders and dynamos on each outer panel, as well as two horizontal bus bars and a middle wire bar behind the board; the balancer bars are provided with sliding guards to prevent the mischance of plugging one of them on both middle and outer wires simultaneously. Each dynamo is connected through a minimum current cut-out and a fuse on either pole, and is provided with a Kelvin ampere gauge. The battery circuits are taken through polarised charge and discharge ammeters.

The measuring panel carries two Weston voltmeters, 205—255 volts; a Crompton booster voltmeter, 0—100 volts; two 220—300 and two 440—560 Kelvin voltmeters, a middle wire 0—150 ampere gauge, a 0—10 ampere gauge in the earth connection, and three ampere gauges for the booster set.

The battery panels are fitted with charge and discharge switches, booster reversing switches and motor starter, emergency switch in middle wire, and the small dynamo shunt switches. The boosters are provided with bus bars by means of which they can be used for (1) battery charge and discharge, (2) milking cells, and (3) supplying current for meter testing, &c.

The battery switches are of Prof. Kennedy's design, similar to those installed at Carlisle and Chester; they are connected with the 10 cells of each battery nearest the middle wire, and are of a specially interesting and ingenious construction. The fixed part consists of a semi-circle of contact blocks connected with the cells, and intermediate contacts connected with small resistance coils behind the board, as well as two complete rings connected, through a reversing switch, with the booster terminals; one of these rings is connected also with the middle wire. The rotating part consists of two pairs of laminated bars, insulated from one another; these are so arranged that one brush of each pair bears on the cell contact circle, while the others bear on the booster rings. The action of the switch is as follows:—For regulation when discharging, the switch is used in the ordinary way to cut cells in or out. When commencing the charge, the battery is first of all charged from the bus bars as far as possible, cells being cut out by degrees as the back E.M.F. rises. When the lowest number of cells is reached, and the assistance of the booster is required, the booster reversing switch is set to "charge," and the booster excited to give an E.M.F. equal to that of the 10 end cells; the battery switch is then moved



Main Switchboard.

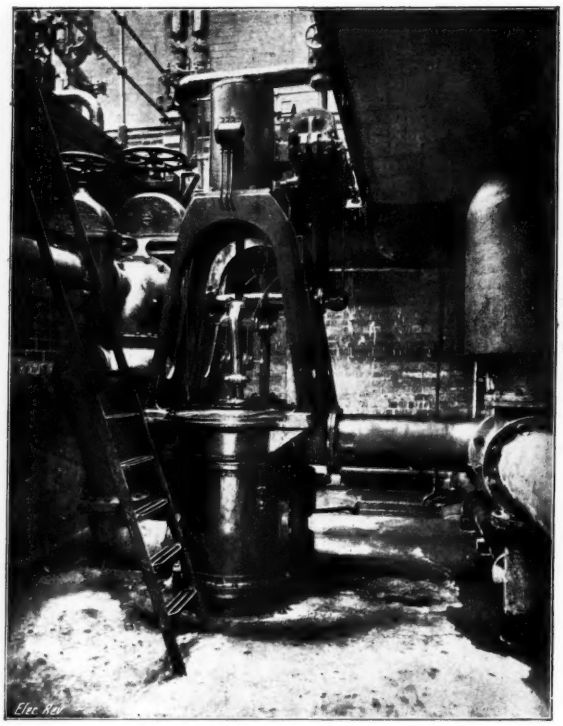
one step further, putting the booster in parallel with the end cells. The pressure is then raised until the booster is sending the same current through the end cells as is flowing through the rest of the battery, after which the battery switch is moved one step further, putting the booster in series with the whole battery, but without affecting the bus

bar pressure or the charging current. The battery switch can then be used to cut out cells from the charging circuit as may become necessary. The booster is used to assist the battery in discharging, if necessary, by operating the switch gear in a similar manner, but in the reverse direction.

To ensure these operations being correctly performed, the battery and booster switches are interlocked, the motions of the battery switch being limited to a travel of 180° by a snail behind the board; there are three working positions, corresponding to charge and discharge with the booster, and running direct without it, and the snail is accordingly provided with three semi-circular grooves, the total motion of the switch thus ranging over 1½ complete revolutions. We were informed that the working of this switch has given great satisfaction.

The regulating slides for the generators and boosters are mounted on the switchboard rail.

The accumulators are of the Tudor type, in glass boxes, 125 cells in each battery, of 250 ampere-hours' capacity. An Aron charge and discharge meter, which registers charge 12 per cent. lower than discharge, is in circuit with each



Jet Condenser and Pump.

battery, and a Chamberlain & Hookham ampere-hour meter in series with each dynamo. A pair of Holden recording voltmeters, made by Pitkin, are also provided.

The cables were made and laid by Messrs. Callender's Cable and Construction Company, Limited, they are all of the concentric type, insulated with bitumenised jute, lead-covered and armoured with steel tape, and are laid direct in the ground.

The feeders have a cross-section of 0·42 square inch; two are taken to a dividing point in the town, where one is split to two feeding points, while the other one and the remaining feeder go to residential districts. The distributors have a cross-section of 0·12, 0 06, 0 12 square inch. The arc circuits consist of 7/16 S.W.G. single cables. Chamberlain and Hookham meters are used on consumers' premises, with Wright maximum demand indicators made by the Reason Manufacturing Company.

The charges for electricity supply are assessed on a scale of rebates, being 7d. per unit for the first hour of use of the maximum demand, and 3d. per unit afterwards, up to 5,000 units per annum; 7d. and 2½d. from 5,000 to 10,000; 7d. and 2d. from 10,000 to 15,000, and 7d. and 1½d. for a supply exceeding 15,000 units per annum. 3d. per unit is charged for power, and 3½d. for church lighting.

The public lighting at present consists of two circuits of 10 arc lamps in series across the 460-volt mains; large additions are to be made to this number. The arcs are Crompton 10-ampere 16-hour single carbon lamps, carried at a height of 23 feet on cast-iron pillars, made by Messrs. McKenzie.

The total private lighting already connected, or shortly to be joined up, amounts to over 7,000 8-c.p. equivalent, while 3,000 more are being wired. These numbers, however, are far from representing the future load of the station. So large is the demand already in view, that the City Council, on the recommendation of Mr. Midgley, has decided to at once proceed to extend the works, and to obtain powers to borrow £20,000 for that purpose. Two Babcock & Wilcox boilers are to be laid down, and two generating sets, each of 200-kw. rating, thus trebling the size of the station. It is hoped, with good reason, that the North-Eastern Railway Company, who own important railway works in the city, will become large consumers for both power and lighting, and other industrial concerns are favourably inclined towards the adoption of electricity as a motive power.

In view of such a successful beginning and rosy future for the undertaking, we cannot but think that the Corporation will regret that it did not take the plunge years ago.

The equipment of the station has been carried out by Mr. E. W. Abbott, on behalf of Messrs. Crompton & Co., while the whole of the work was performed under the supervision of Mr. H. Moore, Prof. Kennedy's representative. Mr. C. A. Midgley, as above stated, is the city electrical engineer, assisted by Mr. J. D. Pember; to these gentlemen, and to Mr. Abbott, we tender our hearty thanks for their kind assistance in the preparation of this article.

"Intensified" Gas at Portsmouth.—The *Journal of Gas Lighting* recently published a note on the results of some experiments which are being made at Portsmouth by the officials of the Portsea Island Gas Company with intensified gas lighting on the Sorazée-Greyson system, which is being introduced by Messrs. Sugg & Co. It is stated that four lamps are now being exhibited outside their offices in the Commercial Road, Landport, and that these lamps "furnish illumination far out-rivalling the arc electric lamp at a cost of 1½d. per hour, as compared with 10d. for the electric light." Enthusiastic advocates of gas are given to making somewhat wild statements when any comparison with electric lighting is raised, but it is not often that they themselves furnish the means of modifying, if not refuting, their own argument. The note goes on to say that the candle-power of the four lamps is 2,700, and that the cost of electricity is 4½d. per unit. Any self-respecting arc lamp will give at least 2 c.p. per watt consumed, hence 2,700 c.p. would correspond to an expenditure of energy at the rate of 1,350 watts, which, at 4½ per unit would cost $4{\cdot}5 \times \frac{1{,}350}{1{,}000} =$ as nearly as possibly 6d. (not 10d.); further, one must not lose sight of the fact that the Sorazée-Greyson lamps require an intensifying apparatus, and that the candle-power will diminish rapidly as time goes on, whereas the candle-power of the arc lamp is not a function of its age, nor does it require any special apparatus to enable it to be used from the ordinary supply mains. Moreover, it must be remembered that an allowance for interest and redemption has to be taken into account in fixing the sale price of the electric current, which item will be greatly reduced in time. As a matter of fact, however, the average price obtained by the local authority at Portsmouth for public lighting is 1 99d. per unit, at which rate 2,700 c.p. from arc lamps would cost $1{\cdot}99 \times 1\ 35 = 2{\cdot}68$d., not 10d. The results of the supply of electrical energy during the financial year of 1898 at Portsmouth show a surplus of £2,091, after covering all charges and providing for interest and sinking fund for redemption of capital.

ELECTRIC TRACTION NOTES.

(*Continued from page* 618.)

The Cape Cable and Electric Tramways Case.—The Cape papers to hand by the last mail contain a full report of the judgment of the Supreme Court of Cape Colony in the action brought by the Eastern and South African Telegraph Company, Limited, against the Cape Town Tramways Company, Limited, to recover damages for the interruption of their business by the working of the electric tramways. The tramways are worked on the overhead trolley system, and the contention of the Telegraph Company was that through the return current being picked up by the outside sheathing of their cable lying on the bottom of the sea within the area of disturbance, a current is induced in the core which has a disturbing effect on the signalling apparatus. By laying a second cable as nearly as possible parallel and near to the existing cable as far as Robben Island in Table Bay, the Telegraph Company have succeeded in reducing the disturbance to a considerable extent. A completely efficacious mode of neutralising its effect would be to lay a twin core cable some distance out to sea. The plaintiff company, who claimed £50,000 as damages, included in the claim the cost of laying such a cable to Robben Island, and its maintenance, together with compensation for the loss of business, and the cost of the parallel cable already laid. The Chief Justice, Sir J. H. de Villiers, in the course of an elaborate judgment, quoted the Acts of the Cape Legislature under which the construction of the tramways was authorised. A proviso to one of the sections makes the defendant company liable for "any electric leak taking place, and any damage being thereby caused by electrolysis or otherwise." There was a difference of opinion among the experts who gave evidence in the case as to whether the word "leak" was applicable to a general and gradual escape of the electric current from the rails. His Honour came to the conclusion that it was not, and that the Legislature having sanctioned the use of the rails for the return current did not intend to comprise in the term "leak" the necessary escape of current from the rails. He was of opinion also that the words "by electrolysis or otherwise," must be construed as meaning physical damage such as the fusion of metal, and not a mere electrical disturbance of signalling apparatus caused by induction. As to whether the defendants were liable under the common law, it was difficult to ascertain what particular legal right of the plaintiffs had been injured. The quantity of the electricity which caused the disturbances was infinitesimal as compared with the total quantity transmitted through the rails, and it did no damage to anyone beyond disturbing the sensitive instruments used by the plaintiffs. The plaintiffs relied upon the case of Rylands *v.* Fletcher, in which the House of Lords decided that if a person brings or accumulates on his land anything which if it should escape may cause damage to his neighbours, he did so at his own peril. He could not find any authority in the Colonial law which went quite so far, and as Mr. Justice Kekewich held in the National Telephone Company *v* Baker that the question of negligence did not enter into the decision of the Court in Rylands *v.* Fletcher, he should certainly not be prepared to hold that it was a binding authority upon that Court. The legal right of the plaintiffs to be protected against the slightest disturbance of their delicate apparatus caused by the indirect effect of induction was by no means clear, and it became still more doubtful when it was borne in mind that by laying a few miles of twin core cable they could have prevented the disturbance. It was true they were first in the field, but when they laid their cable they could not reasonably have expected that in the ordinary course of scientific invention and improvement the whole area through which the cable went would always remain free from electrical disturbance. Judgment would therefore be for the defendants, with costs. Mr. Justice Buchanan and Mr. Justice Laurence concurred, the latter observing that if the plaintiffs had laid a twin cable between August, 1896, and the middle of 1897 there would only have been a period of about three weeks in which the Eastern cable would have been interrupted, and the amount of damage or inconvenience would have been very small.

Glossop.—At last week's Council meeting a letter was read from the managing director for Edmundson's Electricity Corporation, Limited (to whom the Council have transferred the electric lighting order) stating that they were prepared to take the risk of establishing an electric tramway in the borough, partly because of the peculiar positions of the various mills, residential and shop portions of the borough, but chiefly because they believed that by combining the electric lighting and tramways they would effect such economies in the management and working expenses as would make the tramway undertaking a success. The Council, on the recommendation of the Electric Lighting Committee, accepted the proposal.

Gloucester.—We understand that the Joint Streets and Electricity Supply Committee of the Corporation have had the terms suggested for the supply of power to the Tramways Company under further consideration this week. The company sought an abatement of the terms offered, and it was proposed in committee that a reduction should be made. On a division, however, this proposal was negatived, and it was decided to adhere to the original terms. It so happened that on the day that the matter was under consideration it was reported to the Worcester City Council that terms had been come to with the British Electric Traction Company in respect of a light railway scheme of a similar extent, and to serve a similar population. The terms of supply were as follows:—The first 200,000 units per year, 2d. per unit; the second 200,000 units, 1¾d. per unit; the remaining units, 1½d. per unit. The agreement as to price is to be subject to revision at 14 years. We understand that the terms offered by the Gloucester committee to the local company are approximately the same, with one important exception, viz., that Worcester secures a contribution of £5,000 from the company in respect of necessary works of street improvement. It may also be remarked that no rental is asked from the Gloucester company in respect of wayleave, as in some other towns, and that the only charge proposed is that for the supply of electricity. We further understand that the successful issue of Worcester's negotiations has "converted" some of the Gloucester committee—previously all but unanimous on the matter—who voted at the Council meeting last week in favour of waiving some part of the charge.

Manchester—Liverpool.—The Bill to incorporate the Manchester and Liverpool Electric Express Railway Company has been specially appointed for consideration by a Select Committee of the House of Commons, which will commence sitting on Tuesday, May 8th. The Committee will consist of Sir John Kennaway, Mr. John H. Roberts, Mr. Arthur Elliot, and Mr. Charles Douglas. The Bill, it is understood, will be strongly opposed.

New York, Philadelphia and Reading Railway.—The establishment of an electric service between New York and Philadelphia is being considered by the Reading Railway Company. The company have already gone into the question of economy, it is said, and there seems to be little doubt that a reduction in expense would be effected by the introduction of electric traction in the place of steam.

Progress of Electric Traction in France.—The following table, translated from a French contemporary, gives the number of miles of tramway and electric railway in France to January 1st, 1900, as compared with January 1st, 1899:—

	January 1st, 1899.	January 1st, 1900.
Miles of line	829	1,273
Total capacity of generating stations, KW.	18,718	28,308
Total number of motor cars	759	1,295
Number of lines with overhead conductor	42	56
Number of lines with underground conductor	2	3
Number of lines with central rail conductor	1	1
Number of lines operated by accumulators	6	6
Number of lines operated by accumulators and trolley	4	4
Number of lines operated by other systems	1	2
Total number of lines	56	72

The trolley system of course heads the list as a means of conveying the current to the motors, owing to the great economy thereby effected as compared with other systems.

Rhyl.—At a special meeting of the Rhyl Council last week, the Electric Light Committee brought forward a proposal for the extension of the Rhyl and Prestatyn light railway system through Rhyl, travelling the length of the sea front, touching the marine lake, and returning through the principal thoroughfares to the starting point at the Grand Pavilion. The committee showed that the tramway would be a decided advantage to Rhyl, and would help to make the Marine Parade very popular. The overhead wire system was objected to. The Council decided by the casting vote of the chairman to sanction the scheme.

Salford.—In the Town Hall on 4th inst., Mr. A. P. Trotter, electrical adviser to the Board of Trade, opened an inquiry into an application made by the Salford Corporation for sanction to borrow the sum of £227,392, the balance required for the reconstruction and electrical equipment of tramways. The town clerk said that the Corporation would come into possession of the tramway system in April next year, and it was desired to be prepared to work it with electricity by that time. The Salford Corporation Act, 1899, empowered the Corporation to borrow the sum of £250,000 for the construction, and they had power to borrow, on the security of the tramway revenue, the borough fund, and the borough rate, such sum as the Board of Trade might sanction for the purchase of lands and buildings for tramway purposes. The inquiry that day was devoted principally to the equipment of the tramways. They needed £42,892 for poles and wires, £95,315 for cars, £83,380 for land and buildings, and £5,305 for legal and professional expenses. A contract had been made for the purchase of poles, &c., providing the requisite permission of the Board of Trade could be obtained. The system extended to 40 miles, including working provision for Swinton and Pendlebury for 21 years, and for Eccles for 35 years, an agreement having been made with the authorities of those districts under the powers conceded by the Act of 1899. It was deemed advisable to relay the lines and complete the work necessary to institute the altered system by April next year. Perhaps that might be more than they could accomplish, but at all events the granting of powers by the Board of Trade at an early date would facilitate matters considerably. The contracts for the purchase of dynamos and the construction of buildings had already been let. In answer to the inspector, it was explained by the town clerk that terms were being discussed upon which either Salford would supply current to Eccles, or Eccles to Salford, for the working of the system in Eccles. This applied also to Swinton and Pendlebury. The inspector remarked that it was usual not to allow the time for the

repayment of loans to extend beyond 30 years for tramways purposes. The town clerk said that the Act allowed the Corporation a period of 50 years for loans for land, and 30 years for loans for other purposes. Evidence having been given by Mr. E. Hatton, tramways engineer, and Mr. Clirehugh, consulting electrical engineer, the inquiry closed, the inspector promising to report to the Board without delay.

South Staffordshire.—The Board of Trade have sanctioned the use of steam power on the South Staffordshire system for another 12 months.

Sydney (N.S.W.).—The *British Australasian* says that the extension of the North Sydney electric tramway system to Gore Hill was officially opened on the 24th ult. by the Minister of Works (Mr. O'Sullivan). The Minister referred to the success of the electric trams, and stated that statistics showed that the George Street line was carrying passengers at the rate of 19,000,000 a year. A number of new lines were, he said, under consideration, and next financial year the Government hoped to provide for several.

Liverpool.—With reference to the Corporation Tramways accounts, an abstract of which appeared in our last issue, Mr. Henderson expressed surprise at the Council meeting that no reference had been made in the general proceedings of the Tramways Committee to the accounts. He moved that the accounts for 1899 should be referred to the Finance Committee, with instructions to them to examine into the basis of the charge made for the electrical energy supplied, and to report to the Council. It was important to the Council to know that the basis upon which the energy was supplied by the electrical undertaking to the tramway undertaking, which he had not been able to ascertain, was a right and proper foundation. During the past year the total receipts from the electrical tramways was no less than £77,000 odd, which was just one-fifth of the total amount of the whole of the earnings of the tramway account. The cost of the energy supplied by the electric light undertaking for the purpose of earning that £77,000 odd amounted in round figures to the modest sum of £7,500. If the whole of the tramway service had been worked during the past year on the electric system the cost of the energy for earning the whole of the money received would only have been the sum of £35,000, whereas the actual cost for the mere maintenance and keeping of horses and other expenses connected with the horse traction amounted to no less than £144,000—a difference of more than £100,000 a year. They would be only too well satisfied if the electrical energy could be supplied at the price which had been charged, but he had very grave doubts. He felt that the electrical undertaking was liable to be unduly prejudiced in favour of the tramway undertaking. Moreover, the enormous increase in the price of coal was sure to have its effect in the coming year more so than in the past. Mr. Utley seconded. Mr. Dart said the members of the Electrical Committee were directly interested in seeing they got from the Tramways Committee a fair remuneration for the energy supplied. On the other hand, they were not entitled to make a substantial profit. The Tramways Committee was not allowed for 14 years to pay any profits towards the alleviation of the rates, and it would be a most improper thing were the Electrical Committee to charge such a sum as would leave them a substantial profit. That would be doing in an underhand way that which was prohibited by Parliament. He had been most anxious they should not receive less than the proper amount from the Tramways Committee, but it was a matter in which they had to be guided by the skill and experience of their officials. No one was more competent than the electrical engineer to form a fair and adequate opinion, and he was assured that they were receiving from the Tramways Committee full and proper payment. The expense was in providing a generating station for the maximum amount of power required. The result was that as the tramways worked for extremely long hours, the Electrical Committee were enabled to charge a very low rate. They could do the same for the electric light also if those who used it in their houses would burn the light constantly for 16 or 17 hours daily. He had no objection to that being referred to the Finance Committee, because he would be delighted if they found the Tramways Committee could pay them more, but they were not making a loss at all. Alderman F. Smith did not think the proposed inquiry would facilitate matters. The Finance Committee would have to be guided by the advice of the same officials as the Electrical Committee, or else call in experts, with the result that the Corporation would not benefit one farthing. Either the Electrical or the Tramways Committee benefited, and surely they might wait until experience showed them how it stood. Alderman E. Paull remarked that if over £77,000 could be earned at an expenditure of a little over £7,000 for haulage, it showed that when they got the electric system over the whole city there would be an immense profit. He thought the fact that the Electrical Committee might make a profit for the ratepayers whilst the Tramways Committee could not was one strong reason why the latter should be charged the extreme amount. Sir William Forwood could see no possible advantage in referring that matter to the Finance Committee, and was quite certain the Tramways and Electrical Committees were competent to deal with it. Mr. Henderson did not press his motion, and the matter dropped.

Tramways Congress.—An International Congress on Tramways will be held in Paris from September 10th to 13th, under the auspices of the Permanent International Union of Tramways, of which details may be obtained from the general secretary, Mr. F. Nonnenberg, 85, Rue Potagere, Brussels, or from the secretaries of the Paris International Assembly, 5, Henrietta Street. The congress will include in its programme the question of the heating of carriages, of brakes, of electrical traction, &c., and will go thoroughly into the question of tariffs.

Wolverhampton.—An unfortunate hitch has occurred in the negotiations between the Corporation and the British Electric Traction Company, whereby it was hoped that when—as was stated in the Electrical Review last week—the Corporation took possession of the tramways in the borough an arrangement would be made for a continuous service from the borough boundary to the outlying districts of Willenhall, Bilston, and Sedgley. At the meeting of the Town Council on Monday it was announced that the British Electric Traction had written to the Corporation making an offer to the effect that they were prepared to take on the work of the whole of the tramway within and without the borough, so as to keep up the connection between the outlying portions, and pay the Corporation interest at the rate of 6 per cent. on £3,000, the arrangement to be from month to month. The town clerk said that this was not a letter which should be discussed in public. He thought at the present time no further negotiations whatever should take place in reference to any subject mentioned in the letter until the arrangements entered into for the purchase of the Dudley and Wolverhampton portions had been completed. When that had been done, the Tramways Committee would know how to act; but to discuss the question at present would be premature and damaging to the interests of the ratepayers. The Corporation declined to accept the arrangement suggested. The question was then put back to Committee, on the motion of Alderman C. T. Mander, who moved a resolution empowering the Committee to refuse to reopen negotiations on the lines suggested.

The town clerk has been awarded an honorarium of 100 guineas in recognition of his services in connection with the tramway arbitration.

Worcester.—The City Council has come to terms with the British Electric Traction Company, and the draft agreement has been approved. The company undertake within a year to apply for powers to construct certain light railways, to reconstruct other lines, and to take electricity from the City Council at the following terms:—The first 200,000 units per year 2d. per unit, the second 200,000 units 1½d. per unit, the remaining units 1¼d. per unit. The agreement as to price is to be subject to revision at 14 years. The Corporation undertake to buy land for widening High Street, and the company to pay £5,000 towards the cost.

TELEGRAPH AND TELEPHONE NOTES.

The All-British Cable to the Cape.—In the House of Commons on 6th inst. Sir C. Dilke asked the Chancellor of the Exchequer to explain on what grounds the offer to lay an all-British cable from England to Cape Town by Gibraltar and Sierra Leone for a subsidy of £20,000 a year, to connect with the Cape Town-Australia cable, to be laid without subsidy, had been refused by the Government, with the result of the cable now being taken by a route passing through two Portuguese stations; whether the company which made the offer was requested by the Government to lay, maintain, and work a strategic branch cable between Ascension and Sierra Leone at an estimated cost of £150,000, in consideration only of the Treasury finding it unnecessary to oppose the grant of landing rights in Cornwall at a spot where other cables of the same company were already landed with Board of Trade permission; and what precedent there was for refusing landing rights in the United Kingdom to British cable companies.

The Chancellor of the Exchequer (according to the *Times* report) in reply, said:—I cannot give a full answer to the first paragraph (which does not, I think, state the position quite accurately) without going into the history of negotiations, extending over several years and involving other questions besides this, between the Governments of the United Kingdom, the Cape, and Australia, and the cable company. But I may say that one reason for refusing the subsidy of £20,000 a year was that another company had applied for landing rights for a cable to be laid by the all-British route without a subsidy. I think there is now ground for supposing that an all-British communication with the Cape will be obtained in another way. The statement in the second paragraph is correct. So far as I know no steps have hitherto been taken by the Government in this country to obtain any return from telegraph companies seeking landing rights; but the Cape Government have recently obtained substantial concessions as the price of landing rights for this new cable, and it seemed to me that the grant of new landing rights in this country was a valuable concession for which it was my duty in the public interest to try and obtain in this and other instances some return in such a form as the circumstances might indicate to be most desirable.

German Atlantic Cable.—A Reuter telegram from Cologne says that the German Atlantic Telegraph Company gives notice that the two ships having on board the first section of the German Atlantic cable, Emden to Fayal, will proceed to sea on May 1st to lay that section.

Liverpool Cablegrams to the Continent.—In reply to a question put by Mr. Charles M'Arthur in the House of Commons last week, Mr. Hanbury said:—"Under normal conditions the time occupied in the transmission of telegrams between Liverpool and Havre, and between Liverpool and Hamburg, is about 25 minutes in the one case, and 35 minutes in the other. The Post Office has no information as to the time occupied in delivery abroad. Any telegrams sent between Liverpool and Bremen, by way of the United States, would not pass through the Post Office, and the Post Office

has no knowledge of the time occupied in transmission, as compared with the ordinary route. The cable company could not adopt the route *viâ* America consistently with its arrangements with the administrations concerned. It is hoped that the arrangement recently made for the telephoning of telegrams after business hours through the Exchange post office will be found to meet the requirements of the case, and that it should, at any rate, have a trial. At present no great use appears to be made of it, as the number of messages does not exceed an average of six per diem. The Postmaster-General is alive to the importance of efficient telegraphic facilities between Liverpool and the Continent, and measures for improving the communication between this country and the Continent are under discussion between the Post Office and the Treasury.

Glasgow Telephones.—A Glasgow paper says that Mr. A. R. Bennett, general manager of the Corporation Telephone Department, has issued a circular, in which he states that subscribers are now accepted at the following rates:—£5 5s. per annum to cover an unlimited number of calls; £3 10s. per annum and 1d. for each call originated by the subscriber. These rates cover communication with all parts of the Glasgow telephone area. The advantages claimed for subscribers are:—

Speech will be clear and distinct; hearing will not be disturbed by other voices, nor by crackling, rasping and other disagreeable noises; the subscriber's voice will only be heard by the person in communication with him; and celerity of connection and general efficiency of service will be the object of special effort. Corporation subscribers will have, on payment of the usual rates, equal rights with the subscribers of any other telephone undertaking to the use of the Government trunk lines, and will be entitled to call up, and be called up by, all telephone subscribers in every town to which the Government trunk lines extend. The Corporation will relieve their subscribers of any terminal charges which may be imposed by any other telephone undertaking for conversations through the trunk lines to other towns, provided a subscriber's outward trunk calls do not exceed by more than 10 per cent. his inward trunk calls.

In January, 1899, a company fitted up in the City Chambers an experimental automatic telephone exchange connecting the various departments. The exchange, which has given satisfaction, consists of 25 complete instruments, and the Corporation Committee recommend its purchase, the terms being £10 10s. per complete instrument, with a deduction of 25 per cent., making a total cost of £196 17s. 6d.

The Pacific Cable.—On March 15th there was an interesting debate in the Canadian Senate on the Pacific cable, led off by Sir Mackenzie Bowell, who moved the following resolution:—

That the establishment of a telegraph cable across the Pacific to connect Canada with the Australasian colonies has long been regarded as of high importance to the Empire; it having been recognised to be of Imperial importance at the Colonial conferences of 1887 and 1894, affirmed by an agreement between the Home Government and the Governments of Canada, New South Wales, Victoria, Queensland, and New Zealand, and ratified by the Canadian Parliament last session; this House, therefore, regrets that serious delays have occurred in the prosecution of the undertaking, manifestly through the hostility of the Eastern Extension Telegraph Company, which company is now demanding concessions from the Australasian colonies, which, if granted, will imperil the success of the Pacific cable. That this House is of opinion that any further delay in proceeding with the actual construction of the undertaking would be inimical to the interests of the Empire, and strongly deprecates granting any further concessions to the Eastern Extension or any other company.

That it is expedient in granting permission thereafter to private companies to lay cables between British possessions it be on the express condition that the State may assume ownership whenever, in the general public interest, it is advisable to do so.

Sir Mackenzie sketched the history of the all-British Pacific cable scheme from its inception to the present time. He was particularly severe upon the mismanagement of affairs in London, whereby the Eastern Extension monopoly was given time to set about acquiring concessions which threatened the success of the Pacific cable project, and pointed to the unfortunate circumstance that the chairman of the Cable Construction Company was a high official in the Colonial Office, with undoubted powers for interfering with the progress of the Pacific cable scheme. But he hailed with satisfaction the awakened interest of the Imperial authorities in furthering it.

Senator Power thought the proposed contribution of Canada was altogether disproportionate to Canada's interest in the cable scheme. If this country had money to spare, it could be more profitably spent at home; for instance, a geological building was sadly needed in Ottawa.

Hon. R. W. Scott supported the cable scheme as an important factor in uniting the Empire.

The resolution was carried on division.

In the House of Commons on Monday Mr. Hogan asked the Secretary for the Colonies whether he was in a position to report any progress in connection with the proceedings of the Pacific Cable Committee, and whether the difficulties that arose from certain concessions to a competing scheme by some of the Australian Governments had been satisfactorily adjusted.—A reply was given to the effect that the committee had made great progress and was now considering the terms of a report. This report would deal with the offer made by the cable companies to the Australian Governments.

The *Times* Melbourne correspondent on 9th inst. stated that the negotiations between the Eastern Extension Company and the colonies of Victoria and New South Wales with reference to a cable between Australia and the Cape had come to a deadlock. The company demanded that if any cable other than the Pacific cable were laid they should have the right to reduce their rates temporarily in order to fight the competition, reverting, when successful, to the *status quo*. The Governments, however, insisted that the reduced rates should be permanent, otherwise competitors might conspire to kill the Pacific project, and when that was accomplished might increase their rates again. Since the deadlock the company has arranged to concede reduced rates to South Australia and Western Australia under the Cape cable scheme.

Telegraph Matters.—On Monday, in the House of Commons, Sir C. Dilke gave notice on May 1st to call attention to strategic telegraphs, and move a resolution, and Sir E. Sassoon on May 22nd to call attention to the administration of telegraph subsidies.

The Telegraph Wire Export Trade.—Although nothing like so brisk as in the preceding month, March proved to be a very active month so far as regards the exportation of telegraph wire and apparatus connected therewith from this country is concerned. The value of the shipments is returned at £201,940, which compares with £502,816 in the preceding month and £21,870 in March last year. The activity that has prevailed so far in this branch of trade is well indicated by the returns for the three months ending with March, which show a total of £758,819, as compared with only £392,760 in the corresponding period of last year and £248,788 in the first quarter of 1898.

Tunbridge Wells Telephones.—On Friday his Honour, Judge Emden, gave his decision in the case recently heard at Tunbridge Wells County Court, in which the National Telephone Company sought an order from the Tunbridge Wells Corporation permitting it to extend its telephone wires in the streets of the borough, such consent having been refused by the Corporation. His Honour was of opinion that the Telephone Company was placed in the same position as the Postmaster-General. He was of opinion that the contention of non-jurisdiction could not hold good in respect to the refusal of the consent. The question of terms stood over to give the Corporation the opportunity of considering its position.

Wireless Telegraphy.—The Fire Brigade Committee of the London County Council proposes to make a trial of Marconi's wireless telegraphy between the fire stations at Streatham.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast.—April 19th. The Electric Committee wants tenders for the supply of electric motors for a period of 12 months. See "Official Notices" March 30th.

Birkenhead.—April 23rd. The Corporation wants tenders for boilers, economiser, mechanical stoker, steam dynamos, condensing plant, battery and booster, and overhead travelling crane for the tramway power station. See "Official Notices" April 6th.

Corunna.—April 15th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Corunna, stating that tenders are invited by the Corunna Electric Co-operative Society for the supply of a complete set of electrical machinery of 400 H.P., and capable of supplying 12,000 lamps of 10 C.P. All necessary information can be procured from the secretary, Senor Dr. Enrique Sors, 81, Calle Real, Corunna. Tenders should be addressed to the President, Senor Dr. Manuel Baifa, Calle Zafateria, No. 5, Corunna, before April 15th.

Dublin.—April 26th. The Electric Lighting Committee wants tenders for six Lancashire and four water-tube boilers and two economisers; two 1,000-KW. and two 500-KW. low speed polyphase generators for the electricity supply scheme. See "Official Notices" March 9th.

Dundee.—April 25th. The Town Council wants tenders for a traction switchboard for the electric station. See "Official Notices" April 6th.

Germany.—April 20th. The Prussian State Railway authorities at Posen are inviting tenders until April 20th, for the supply of 45 tons of iron wire 4 mm. diameter, and 6,500 porcelain insulators. Particulars may be obtained for 6d. from, and tenders are to be sent to, Die Königliche Eisenbahn Telegraphen Inspection, Posen.

Glasgow.—April 18th. The Corporation wants tenders for the supply of telephone cables (including drawing into conduits and jointing); and telephone instruments (wall and table). See "Official Notices" March 30th.

Halifax.—The Electricity Committee wants tenders for a year's supply of electricity meters; and the Tramways Committee for the supply of various parts in connection with the overhead equipment of new lines. See "Official Notices" March 30th.

Mariupol.—May. The Secretary of State for Foreign Affairs has received a despatch from H.M. Consul at Taganrog, stating that tenders are invited by the municipality of Mariupol, not later than May 16th (29) next, for the construction and exploitation of an electric tramway and the installation of electric light in that town. Particulars may be examined on personal application at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Southampton.—May 1st. The Corporation wants tenders for a 300-KW. continuous current generator coupled direct to a medium speed vertical compound steam engine for the electricity works. See "Official Notices" to-day.

the question of tariffs.

States, would not pass through the Post Office, and the Post Office

Sunderland. — April 27th. The Corporation wants tenders for the supply of two additional switchboard panels with instruments, &c., for the electric lighting station. See "Official Notices" April 6th.

Wimbledon.—April 24th. The Wimbledon Council wants tenders for electric light wiring, fittings, &c., at the new isolation hospital. See "Official Notices" to-day.

CLOSED.

Gloucester.—The National Electric Wiring Company has obtained the lighting of the Guildhall and New Public Library, Gloucester, the total amount of 8-c.p. lamps being 1,826.

London.—The London County Council on Tuesday received the following report by the Bridges Committee in relation to the electric lighting of the approaches to the Blackwall tunnel :—

Some trouble has arisen in connection with the cables feeding the lamps in the open approaches to the Blackwall tunnel, and it has been ascertained that the cause is owing to defects in the manufacture of the cables. The firm who supplied them have been called upon to bear the expense of making them good, and a sufficient sum has been retained by the Council under an award to meet the cost. As the firm are in liquidation we did not think it desirable that the Council should require them to do the work, and we therefore gave instructions for tenders to be invited from six firms for the necessary cables and supplying and fixing eight standards and lanterns on the parapets of the stone steps leading from the entrances to the tunnel to the street above. The following were received by the Council on March 20th—

	£ s. d.	£ s. d.
The British Insulated Wire Company—		
Part 1, supplying cables	393 17 4	
Part 2, supplying lamp standards .	163 0 0	
		553 17 4
The St. Helen's Cable Company—		
Part 1, supplying cables	650 0 0	
Part 2, supplying lamp standards..	140 0 0	
		790 0 0
Messrs Tyler & Duncan—		
Part 1, supplying cables	622 0 0	
Part 2, supplying lamp standards..	186 0 0	
		808 0 0

On examination of the tender submitted by the British Insulated Wire Company, it was found that the cable they propose to supply will be tested under a pressure of 2,500 volts, whereas the specification prescribes a test at 10,000 volts. The company's attention was called to the discrepancy, and they have submitted an amended tender which increases their quotation for part 1 from £393 17s. 4d. to £464, part 2 remaining unaltered. It will be seen that the firm's tender is still much the lowest of those received.

The committee accordingly recommended the acceptance of that company's tender.

London.—The Shoreditch Vestry have accepted the tenders of the St. Helen's Cable Company, and Messrs. W. T. Glover and Company, for the supply of cable during the ensuing year. The Vestry have referred to the Lighting Committee the following two tenders for the supply of transformers :—

Electrical Construction Company	£9,046
Siemens Bros. & Co.	6,645

London.—The Islington Vestry have accepted the following tenders for electrical stores during the ensuing year as per the numbers in the schedule :—

Nos. 1, 2 and 3 (carbons)	The Sloan Electrical Company.
Nos. 5 to 12	Hands, Limited.
Nos. 13 to 38	The Edison & Swan United Electric Light Co.

Rainhill.—A large number of tenders were submitted for the five contracts for the electric lighting installation at the County Asylum, Rainhill, for which Mr. T. L. Miller, of Liverpool, is the consulting engineer. The following is a list of the accepted ones :—

Contract No. 1.—Messrs. A. Anderton, £2,735. (The lowest tender was of £2,550, and the highest £4,800, the latter not according to specification.)
Contract No. 2.—Messrs. Lowdon Bros.
Contract No. 3.—Chloride Electrical Storage Syndicate (including maintenance) £2,850. Lowest tender, £2,332; highest, £3,915. Six tenders were incomplete.
Contract No. 4.—The St. Helens Cable Company, £2,336 (10 years free maintenance). Lowest tender, £1,597; highest, £2,948.
Contract No. 5.—Messrs. Lowdon Bros., £3,460. Lowest tender, £2,896; highest, £7,600.

West Bromwich.—The Electric Lighting Committee of the Corporation have accepted the tender of Mr. Mallin for buildings and shaft at the new generating station, and of Messrs. Spencer, Limited, for roofs.

Whitechapel.—The District Board of Works has accepted the tender of Messrs. Babcock & Wilcox, Limited, for the supply of two boilers and a feed pump, and for removing two existing boilers, &c., to the new power house, for a total cost of £3,097. The tender of the Reason Manufacturing Company, Limited, for the supply of meters up to June 30th, 1901, and for their maintenance to midsummer, 1902, was also accepted.

West Ham.—The Town Council has accepted the tender of Messrs. J. H. Senior & Son for street posts for lighting and tramways.

FORTHCOMING EVENTS.

Saturday, April 14 h.—Royal Institution. Lord Rayleigh on "Polarised Light" (Lecture VI.).
Monday, April 23rd.—At 8 o'clock. Institution of Civil Engineers. The eighth "James Forrest" lecture, by Sir William Preece, K.C.B., on "The Application of Electricity to Engineering."
Wednesday, April 25th.—At 8 p.m. Institution of Mechanical Engineers. Dinner.
Thursday, April 26th.—At 8 p.m. Institution of Mechanical Engineers. Meeting.
At 8 p.m.—Institution of Electrical Engineers. Meeting.
At 3 p.m.—Royal Institution. First lecture on "A Century of Chemistry in the Royal Institution," by Prof. Dewar, F.R.S.
Friday, April 27th.—At 8 p.m. Physical Society.

NOTES.

Becquerel Rays.—The Becquerel rays, like the cathode rays, and unlike the Röntgen rays, are deflected by a magnetic field. This points to the view that these rays are material particles charged with electricity. J. J. Thomson has shown that the mass of the charged particles, in the case of the cathode rays, is very much smaller than that of the chemical atom, and that the electric charge of these particles or corpuscles is always negative. Recent experiments show that the charge of the Becquerel corpuscles is also negative, thereby proving another remarkable similarity between the cathode and the Becquerel rays. These results are mostly due to M. and Mme. Curie and to M. Becquerel. An ingenious method of experimenting devised by the latter, is to place a piece of radium in a leaden box with a small aperture at the top, through which the Becquerel rays can pass. The box is placed on a photographic plate covered with an aluminium plate. When the rays are exposed to the action of a magnetic field they are bent downwards, and make an impression on the photographic plate, the position of which depends on the strength of the magnetic field. The aspect of the photographic plate shows that the emission is complex, since the same field acts in a different degree on the various rays emanating from the source. When absorbent screens are interposed in the path of the rays to the photographic plate, it is found that the rays which are most deflected are first cut off by the screen, *i.e.*, the particles with the smallest velocity are most readily absorbed. Not only has it been proved that the Becquerel radiation carries off a negative charge, but it has also been shown that the radiant material becomes positively electrified.

A Mare's Nest.—We described recently some remarkable photographs obtained by Mr. J. Webb, at Dover, which were considered by Sir George Stokes to give evidence of "Nature's wireless telegraph." Discharges of most complicated shape were seen on the photographic plate proceeding from the arcs of electric lamps, and were supposed to be induced by lightning discharges. Sir George Stokes now acknowledges in *Nature* that evidence has been laid before him which satisfies him that the camera was lifted before the cap was put on, and the image of the arc moving on the plate drew the lines which have led to the waste of so much scientific acumen.

Westinghouse Works.—*Commercial Intelligence* reports a representative of the British Westinghouse Electric and Manufacturing Company, Limited, as saying that "all of two years will pass before the new works which the company are building near Manchester are completed." We suppose we may take this as correct, for a month or so ago we read that the company was making its own bricks. Perhaps the supply of straw has run short! Or can it be that iron work which an American company was going to supply in four months, as we were told at the meeting held in August last year? It was then remarked that "if they let out contracts in England just now for such works, the makers could not deliver within two or three years." In fact, the Americans were going to out-Atbara Atbara. Shareholders were told that "Mr. Westinghouse was of opinion that the building of the works would proceed in a manner unprecedented in England, and in a record time." It looks as though Mr. Westinghouse knew what he was saying, and that his "opinion" will turn out to be true, but perhaps not altogether in the way we thought he meant.

Australia under the Cape cable scheme.

works. See "Official Notices" to-day.

Recent Electric Locomotives for Shunting and Mining Work.—Two electric locomotives have recently been built by the Benrather Maschinen fabrik Allgemeine Gesellschaft, in co-operation with the Union Electricitäts Gesellschaft, one for shunting purposes and the other for use in a mine. The former is now in use in steel works at Hoesch, and the latter, which possesses specially high tractive force, is working at Esch, in Luxemburg. In the first-mentioned loco. the driving axle is carried in bearings cast on the main body of the motors, the back of the motor being carried on springs, so that any relative movement due to inequalities, &c., in the rails will not affect the relative positions of the teeth in the reducing gear. Closed motors of the usual type for this work are used. They run at the comparatively low speed of 275 revolutions per minute. Each of the two motors yields 23 H.P. at 500 volts. The gear-wheels are in the ratio of 1 : 3·5, having 30 and 105 teeth respectively. The driving wheels are 29 inches in diameter. From these figures the speed should be about 7 miles per hour and the tractive force about 2,420 lbs. Both the shunter and the mine loco. are fitted with series parallel controllers. The shunter works, of course, upon the normal gauge of 4 feet 8½ inches. The conditions under which the mine loco. had to work introduced many points of difficulty in the design. Owing to the limitations in size and the small gauge (27½ inches), and to the fact that the wheel base had to be kept small on account of the sharp curves, it was not found possible to get the necessary adhesion with the normal sizes of motor and other parts. As a consequence these were all made unnecessarily heavy, and even then ballast had to be loaded up on the engine in order to enable it to exert the required tractive force. The total weight of the locomotive is 18 tons. In order to exert a force of 3 tons as required, a coefficient of friction of 1·5 is involved, which is higher than that usually found, so that an ample sand box is provided. The specified speed is low, only about 4 miles per hour. The motors run at 525 revolutions per minute, and yield 45 H.P. each, or 90 together, at 500 volts. The speed of the motor is reduced in the proportion of 10 to 1; this had to be effected in three steps. Current is supplied by an overhead line and conveyed to the motors by a specially designed collapsing trolley pole which has to work under greatly varying heights of overhead conductor. In the lowest position the conductor is only 18 inches above the top of the locomotive, and at the highest point 6 feet 4 inches above the top. The locomotives are described at length, and the more important details illustrated in the *Zeitschrift des Vereins deutscher Ingenieure* this week.

Researches on the Conductivity, Specific Gravity, and Surface Tension of Aqueous Solutions containing Potassium, Chloride and Sulphate.—In papers read before the Nova Scotian Institute of Science it has been shown that it is possible, by the aid of the dissociation theory of electrolytic conduction, to predict the conductivity and other physical properties of a solution containing two chlorides or two sulphates, with data as to the conductivity and the other physical properties obtained by observations on simple solutions of these salts. At Prof. MacGregor's suggestion, James Barnes, of Dalhousie College, Halifax, N.S., has carried out experiments with the object of testing this possibility for a solution containing a chloride and a sulphate with a common cation. The electrolytes selected were potassium chloride and sulphate. The observations on conductivity and specific gravity were made by Mr. Barnes, while Rother's observations on surface tension were used. The experiments were made in the Physical and Chemical Laboratories of Dalhousie College, Halifax, during the session of 1898-99. The first part of the paper is concerned with a description of the apparatus and methods employed in the research. A large number of experiments were conducted which space will not permit us to notice in detail; but in the opinion of Mr. Barnes, his results show that it is possible by the aid of the dissociation theory and with data obtained from the simple solutions, to predict the conductivity, specific gravity, and surface tension, of fairly dilute solutions of potassium chloride and potassium sulphate, within the limit of experimental error. The original paper may be consulted in the *Transactions of the Nova Scotian Institute of Science* Vol. x., pages 49—66.

A Hint to Company Promoters.—According to an English chemist the relative light giving and heating capacities of well-known mediums are as follows:—

	Heat.	Light.
Gas	98 per cent. ...	2 per cent.
Electricity (incandescent) ...	95 „ „ ...	5 „ „
Glow worm	1 „ „ ...	99 „ „

We may shortly expect the issue of "Glow Worms, Limited" (which, however, would be a misnomer, as unlimited glow worms would be required) formed for the purposes of acquiring and further developing the lighting capacity of glow worms. A special feature in the prospectus would be the acquisition of a patented method (yet to be devised) for automatically inducing the glow worm to glow at the word of command, thus doing away with all expensive switching arrangements. The promoters will rely upon the instinct and self-respect of the glow worm to at all times when called upon emit or otherwise produce a light of a candle-power as may be from time to time required by the London County Council, or other the local authority concerned with the protection of the public interest. No glow worm will be required to glow more than eight hours per day, nor will any glow worm under a certain age be permitted to exercise his or her function as a light giver, the limiting age to be prescribed by the Board of Trade or other the authority for the time being appointed for this purpose. The relative cost of light per 1,000 candle-hours would be as follows:—

Gas	... 12d.
Electric light	... 25d.
Glow worm	... A little under 0·0d.

The number of glow worms necessary to produce 1 C.P. is variously estimated by figures, the lowest of which starts some distance the other side of infinity. On the other hand, the promoters are convinced that glow worms can be obtained at a very low cost. The directors will confidently anticipate an immediate and large revenue.

The Advantages of Cable Traction.—The Edinburgh cable trams are working very successfully—from an electrical point of view—a few more hitches will doubtless lead to a public agitation for the adoption of what Bailie Mackenzie seems to regard as inevitable, viz, electric traction. We often heard of cars "breaking loose" on the Highgate Hill cable line in the old days, but the fault at Edinburgh last week was a "tight brake." A car suddenly came to a standstill, and refused to budge, in fact, it was quite incabable of doing so, until a "brake-down" gang came an hour later. They then freed the car brakes, releasing the car, and so unblocked the route. The City of Edinburgh might do worse than follow in the footsteps of the New York Metropolitan Tramways. The cable lines now being finished, is it too soon to make a change? We commend this Edinburgh hitch to a contemporary which sometimes indulges in cartoons. Picture two comely dames precipitated on all fours in the roadway without previous notice having been given, the contents of the conductor's money bag shaken out like sand across the tramway track, a crowd of small boys, careful of the conductor's interests, gathering up the fragments that nothing be lost, and an old gentleman sitting in the car reading the ELECTRICAL REVIEW, when all of a sudden he is slanted, also without notice, at an angle of 45° through the glass window. His apologies are profuse, and his "Dear me! dear me!" perhaps emphatic, and what follows "may be better imagined than described." More hitches of this kind, and electrical engineers will regard the trams as "hopelessly incabable."

Royal Institution.—The following are among the lecture arrangements at the Royal Institution after Easter:—Prof. Dewar, four lectures on "A Century of Chemistry in the Royal Institution." The Friday evening meetings will be resumed on April 27th, when a discourse will be given by the Right Hon. Lord Kelvin on "Nineteenth Century Clouds over the Dynamical Theory of Heat and Light;" succeeding discourses will probably be given by Prof. J. A. Ewing, Sir Henry Roscoe, and others.

The eighth "James Forrest" lecture, by Sir William Preece, K.C.B., on "The Application of Electricity to Engineering."

was saying, and that his "opinion" will turn out to be true, but perhaps not altogether in the way we thought he meant.

Acetylene Light Compared with Other Lighting.—In a paper by Herr von Lemmers-Danforth on the cost of acetylene lighting, the following table is given for the relative cost of light by other agents. The figures include a proportion for water, labour, interest, and redemption of capital, depreciation of buildings (5 per cent.) and machinery (8 per cent.).

Approximate Cost of 16 Candle-Hours.

Electric arc lamp...	0·025 to 0·0625 pence.
Petroleum incandescent light	0·05 "
Auer incandescent light (assuming 40 c.p. as average during life and including renewal of mantle)	0·094 "
Acetylene	0·2 to 0·3 "
Electric glow lamp (assuming cost of energy at 5d. to 7½d. per kw.-hour, and not taking into account the diminution in candle-power)	0·25 to 0·375 "
Ordinary flat-flame gas burner	0·35 "

It is not stated upon what assumptions these results are obtained other than as set forth in the table. The author gives the cost of production of one cubic metre of acetylene at 2s. 2d. in the case of a plant producing 540 cubic metres per year, and at 1s. 5¾d. when the production rises to 18,000 cubic metres per year. Acetylene is used in the Prussian State Railway for carburetting the oil gas used in lighting the carriages. The burner most frequently used yields about 5 c.p. with a consumption of 0·956 cubic feet of ordinary oil gas. This may be increased to 11 candles when the very best oil gas is used, but these figures are increased to 15 and 20 candles when a mixture of 75 per cent. oil gas and 25 per cent. acetylene is used. The cost per 8 c.p. hour becomes 0·2d. as against 0·3d. when oil gas only was used. It is claimed by the Allgemeine Elektricitäts Gesellschaft that on a large scale passenger carriages can be lighted electrically at a cost of 0·225d. per 8 c.p. So far, however, this figure does not appear to have been reached in practice.

Novel Application of Electric Heat.—Considerable trouble and inconvenience have been experienced at Marquette, one of the most prominent towns in the upper peninsula of Michigan, by ice getting into the intake pipe of the waterworks during winter, choking it up, and in very many cases during the past few years necessitating the closing down of the pumping station, thereby bringing about a water famine. Hitherto the mouth of the intake has been thawed out by means of salt, but, of course, such a remedy has only disposed of the evil temporarily, and the trouble has assumed such proportions that the authorities have seriously contemplated changing the position of the intake pipe and pumping station. This, of course, would involve many thousands of pounds. The trouble is not occasioned by the surface ice of the lake, which is rather a protection than otherwise. When, however, the ice fields are carried out of the bay by winds, these same winds prevent new ice forming on the surface. Small particles of ice—"needle ice"—then form, and innumerable particles are carried into the intake massed together. This winter, on the occasion of an unusually severe water famine, the authorities consulted some engineers, with the result that an electric heater of cylindrical form has been constructed, and has been hung concentrically with the mouth of the intake pipe. The heater is of the iron-resistance coil pattern, and the only novelty about it lies in the use to which it is to be put. It consists of an inner and outer shell, respectively 19 and 21 inches in diameter, and both 5 feet in length. Asbestos sheeting half-an-inch thick is wrapped round the inner cylinder, and on the asbestos No. 18 iron wire is coiled in a continuous spiral. It is believed that enough heat will be generated to prevent the making of "needle ice" in the intake. It is only proposed to use the heater when the direction of the wind favours the formation of this ice.

Municipal Trading.—After a debate extending over several nights, the House of Commons last week, by 141 to 67 votes, appointed a Select Committee of five members "to join with a Committee of the Lords to consider and report as to the principles which should govern powers given by Bills and provisional orders to municipal and other local authorities for industrial enterprise within or without the area of their jurisdiction."

Researches on the Finding of the Ionisation of Complex Solutions of Given Concentration and the Converse Problem.—In a paper communicated to the Nova Scotian Institute of Science in 1895, Prof. J. G. MacGregor described a method of determining the ionisation coefficients of two electrolytes, with one ion in common, in the same dilute aqueous solution. The method described was developed in the study of complex solutions which had been formed by the mixture of simple solutions of known concentration, and involves a knowledge of their concentrations. Even if the complex solutions have not been formed in this way, but have been prepared, say, by the addition of known quantities of the electrolytes to a known quantity of water, they may always be imagined to have been formed by mixture of simple solutions; and in the usual case in which the solutions are so dilute that no change of volume would have occurred in forming them by mixture, the concentration of the simple solutions by the mixing of which the given complex solution might be formed, can readily be determined. But a simple modification of the method renders it applicable in such cases directly; and when so modified, its application is found both to require fewer data with respect to the conductivity of simple solutions of the electrolytes involved, and to be subject to fewer sources of error, than in its old form. As modified, also, it is found to be readily applicable conversely to the determination of the concentration which such complex solutions must have in order that they may have any given possible state of ionisation. In a more recent paper (*Transactions of the Nova Scotian Institute of Science*, Vol. x., pages 68—78) Prof. MacGregor describes this modified form of the method, and points out how it may be used in determining concentration when the state of ionisation is given. The author takes this opportunity, also, of comparing it with two other methods which have recently been employed, of determining the ionisation coefficients for solutions of the same degree of complexity. Prof. MacGregor's paper is extremely mathematical, and is copiously illustrated by curves and numerical tables which are not suitable for useful abstraction or condensation. Those of our readers who are interested in the subject will find the original paper given at length in the *Transactions of the Nova Scotian Institute of Science*, Vol. x., Session 1898-99, pages 66—78.

Solid Hydrogen.—A crowded and distinguished audience assembled at the Royal Institution last Friday to hear Prof. Dewar's lecture on "Solid Hydrogen." In regard to the uses of liquid hydrogen for scientific research the lecturer showed first how it afforded the only means of obtaining solid hydrogen. The behaviour of metals with regard to electrical conductivity at very low temperatures was a very interesting question. From experiments with liquid air it was expected that at the zero of absolute temperature pure metals would have no electrical resistance at all. But although the resistance curves appeared to be going straight to zero at the temperature of liquid air, he found that lower down below the temperature of solid air they bent sharply down, so that a finite resistance was indicated.

Appointments Vacant.—A mains superintendent is required for the Ayr electricity department at £125 per annum. See "Official Notices" to-day.

A second assistant lecturer is wanted in the physics and electrical engineering department of the Blackburn Municipal Technical School. See "Official Notices" to-day.

A lecturer in electrical engineering is wanted for the Bradford Municipal Technical College at £200 per annum. See "Official Notices" to-day.

The Northern Society of Electrical Engineers.—On Tuesday last at the Grand Hotel, Manchester, the paper by Mr. C. E. Grove on "The Electrical Equipment of Ships of War," read at the last meeting of the Institution of Electrical Engineers, was read for discussion.

Information Wanted.—A correspondent writes:—"Could I, throughyour valuable journal, get to know a good formula for paste for a dry cell? Trusting someone will be kind enough to give me the information."

in the *Transactions of the Nova Scotian Institute of Science* Vol. x., pages 49—66.

succeeding discourses will probably be given by Prof. J. A. Ewing, Sir Henry Roscoe, and others.

Lectures.—On Monday last week Mr. Leonard Andrews delivered a lecture, with numerous electrical experiments, at Hastings, in aid of the local fund for the soldiers' and sailors' families. The Mayor presided.

A paper on "The Protection of Public Buildings from Lightning," with special reference to the author's re-arrangement of the lightning conductors of St. Paul's Cathedral, will be read by Mr. Killingworth Hedges, M.I.C.E., at the Royal Institute of British Architects on April 23rd.

Personal.—Mr. Joseph Bastick, late managing director of the Birmingham Carbide Company, has accepted a position with the United Alkali Company, Limited, at Widnes.

Mr. P. F. White has been appointed engineer of the Bangor Corporation electricity works at a salary of £150 per annum.

The Glasgow Tramways Committee recommend the appointment as assistant electrical engineer of Mr. M. B. Field, London. He has had great experience in three-phase work, gained chiefly in the service of Messrs. Brown, Boveri and Co, Baden, and this experience will of course be of great value at Glasgow.

Municipal Electrical Association.—The annual convention of this Association will be held at Huddersfield from June 20th to 23rd. Mr. A. B. Mountain is president.

CITY NOTES.

Brockie-Pell Arc Lamp, Limited.

The fourth ordinary general meeting of this company was held on Monday at the new premises, 60, Worship Street, E.C., Lord Suffield presiding.

In moving the adoption of the report, which has already appeared in our columns, the Chairman said that at the last meeting he expressed the hope that they would have a better balance-sheet this year, and he was glad to say that hope had been fulfilled, and they hoped that the present accounts would be followed at no distant date by accounts which would warrant their paying dividends. The business had shown a steady rate of increase throughout the year. Not only had they made further important contracts for lighting, but had carried out satisfactorily those they had in hand. The lamp had fully maintained its reputation among old friends, and had gained for them important new customers. The works were fully occupied, and would be so on existing contracts for some time to come. In the accounts they had made provision for various items in which there would be depreciation, but, at the same time, the plant, tools, and other items had been maintained in the fullest efficiency, and the cost had been further debited in the accounts. They had suffered in profits by the very high prices of materials, which prices were continuing. The directors had endeavoured to help the company by reducing their fees by three-fourths, and every effort had been made to reduce expenditure, but in such a business as this the technical and staff expenses were heavy. These would be increased only in a small ratio as the trade increased. The new premises would be found to be better suited to the business of the company, a business requiring much room for stock and storage. They could do at least three times as much trade in the new premises as they could do at the old, which were most unsuitable. Moving was a heavy matter, but the bulk of it had now been done without any stoppage of work, and the remainder would shortly be carried through. The prospects of the company, and the general improvement in its condition, was principally owing to Mr. Shrimpton. They had had a very hard time, but they had turned the corner, and the company was in a good position, and would go on and progress. They had certain difficulties to contend with, of which they would, he dare say, hear further sooner or later. He had told them of the difficulties as to cost of materials, and whatever they might have to say further had, perhaps, better be left to a later occasion.

Sir F. D. Dixon-Hartland, Bart., M.P., in seconding the motion, said it was the third time he had been privileged to second the adoption of the report, but it was the first time he had any pleasure in doing so. They were in a different position now, compared to what they were in 12 months ago. They then had a debit balance of £1,500, but to-day, instead of a debit, they had made £1,250 profit, which was a difference of £3,000. Last year they had many difficulties with regard to the working; they did not all pull together. The directors had one view, others had another, but all those difficulties were past now, for they were a united board and *personnel*. The old premises were a difficulty, the new ones were eminently suited for their purposes. As to the directors' fees, they stuck to the ship not because they wanted to remain as directors, but because their honour was concerned, and they would try to make this company the success which they thoroughly believed it would be from the beginning. They had obtained Mr. Shrimpton's services as managing director for a number of years. He could endorse all that the chairman had said about him.

After a few friendly criticisms had been offered by Dr. Fagan, Mr. Shrimpton replied on several matters. At the new works they had put in electric motors, and done away with their oil engines. They considered that the 5 per cent. depreciation was ample. They had had no occasion to consult Mr. Brockie, their consulting engineer, and he hoped they would not do so, as they could not forget the past history of the company. He was available if they required him, but they had learned how to make lamps, and the technical management of the business had never been in a healthier or sounder position than to-day. As to the electric lathe, they were not certain that it was an asset at all. It had been brought forward year after year; if it was an asset they still had it, but the foreign patents and the lathe were no longer put into the balance-sheet, as they wanted nothing there but the most substantial facts. Those things had been brought forward by those responsible for the early management of the company, but they were not the company's business. They had plenty to do, and had not time to occupy themselves with a lathe, though he believed it had some excellent points. They had not the capital to develop it, and tool-making was a very difficult industry. They could not take their works farther out, as they were afraid their workmen would not follow them. They were managing as economically as possible. They had replaced men with boys wherever they could, and would continue to do so. It was possible that a little time hence they might have to take legal proceedings again.

The report was carried unanimously, and the Hon. R. Brougham having been re-elected a director, and the auditors re-elected,

Sir Dixon-Hartland proceeded to lay before the meeting suggestions with respect to the matter of capital. He had wondered how Mr. Shrimpton had managed to do so much with such a little capital. There were two ways in which they might provide more money; (1) the issue of debentures in proportion to their holdings of shares; (2) the re-constitution of the company so as to create fresh capital. After giving his own views of the matter, the speaker suggested, after conversation with Dr. Fagan, that a committee of the 10 largest shareholders should meet to consider the matter, and then bring it later before an extraordinary meeting.

Westminster Electric Supply Corporation.

We read in some morning papers that the "board of the Westminster Electric Supply Corporation would seem to be divided against itself." An official announcement has recently been made of the contemplated creation of 20,000 new shares of £5, to be offered *pro rata* to the existing shareholders at £10 apiece—that is, at £5 per share premium. As the old shares are selling in the market in the neighbourhood of £15, it will be seen that an acceptable little bonus would accrue to those of the proprietors who took up their allotments. Two members of the board, however, Mr. R. W. Wallace, Q.C., and Mr. Joseph Browne-Martin, have issued a counterblast to the manifesto of their colleagues, in which they hint at "a strong feeling that the shareholders should obtain the full benefit of any future issue of capital." They accordingly ask for support to a resolution to sanction the increase of the capital of the corporation from £399,500 to £550,000 by the creation of 30,100 ordinary shares of £5 to be issued at par to the shareholders *pro rata* to their holding in the company. This would allow of the allotment of, roughly speaking, one share in 13, representing a bonus of, say, 15s. per share. Messrs. Wallace and Browne-Martin state that several shareholders in the company have asked them to take the lead in support of the policy of issuing the new shares at par on the ground that other well-known companies which have followed this principle have been eminently successful, and their shares in consequence stand at exceptional premiums.

A meeting of the company was held on Wednesday, at which Lord Suffield moved for the creation of 30,100 ordinary shares of £5 each at £10 a share. Mr. Boulnois, M.P., seconded. Mr. Wallace then moved an amendment that the shares be issued at par to shareholders. The amendment was carried by 27 votes to 19. A poll was demanded and was fixed for May 11th, Mr. Wallace protesting, as he had a large number of proxies.

Folkestone Electricity Supply Company.

The fourth ordinary general meeting of this company was held on March 31st, Alderman Spurgen presiding. The report has been already published in our columns.

The Chairman congratulated the shareholders on the success of the undertaking. The capital expended during the year 1899 had been £21,400, increasing the total outlay of the company to over £64,000. The capital of the company was only £54,000. The directors had decided to issue £25,000 of debentures at 4½ per cent., which he hoped the shareholders would come forward and take up. They had had an unprecedented number of applications for lights during the year, and found they were unable to go on satisfying the demand unless they made provision for additional new machinery and for the extension of the buildings. When they started they considered that provision for supplying 10,000 or 12,000 lights would be sufficient for some time; but during the last year their business had increased by over 7,000 8 c.p. lamps—from 10,089 to 17,334. During this year up to the present time they had put in 1,111 additional 8-c.p. lamps, and there was every indication of the demand increasing. As a matter of fact, they had applications now for another 500 odd lights to be put in next month. With regard to the number of lights put on last year, 7,745, he must explain that 4,540 of these were installed in the second part of the year, so that when they told the shareholders that at the end of the year there were 17,834 lights on it must not be taken that the full revenue had been earned from these during the year. More than half the total increase was put on in the second half of the year, and 1,500 in September. Now they were starting the year with 17,834, and had installed 1,111 since, and he believed he would be near the mark in saying they would put in 500 lights a month for every month in the year.

and provisional orders to municipal and other local authorities for industrial enterprise within or without the area of their jurisdiction."

"Could I, throughyour valuable journal, get to know a good formula for paste for a dry cell? Trusting someone will be kind enough to give me the information."

He showed that during the past year the number of units sold by the Folkestone Company was 209,931, whilst the revenue received from this source was £4,156 8s. 6d., giving an average cost to the consumer of about 4⅝d. per unit. He believed that in time even this would be reduced. This was the first year of working, and they proposed to pay a 4 per cent. dividend. There was nothing concealed; they were paying an honest 4 per cent. When they raised the new debenture capital, and were in a position to take up all the business likely to come to them, he felt sure that year by year the company would go on increasing. One item in the report he wished especially to refer to; it was £2,709 16s. 6d. for installation work for consumers, on which a profit of only £20 1s. 6d. had been brought into the year's accounts. Some shareholders might think this a very little profit on such an outlay, but the company were anxious to get as much business as they could, and a great many people said they would like to have the electric light, but they could not face the initial cost of the installation into their premises. The company had, therefore, put in installations at practically cost price, and the £20 odd shown in the accounts was just a small margin of profit made. By this means they had gained many consumers, on the supply of light to whom they made a profit. The directors desired to offer an expression of appreciation to Mr. Hesketh, their engineer, and the members of the staff.

The motion was carried unanimously.

Winchester Electric Light Company.

The annual meeting of this company was held at the offices at Winchester on Tuesday, April 10th, Mr. T. F. Kirby, chairman, presiding. In their report the directors stated that they were satisfied with the reception of the electric light in the town, 10,000 8-c.p. lamps having been connected up to the end of last year, and further applications continued to be received. The accounts showed a balance to net revenue account, after paying all expenses, amounting to £323 12s. 2d., of which it was proposed to apply £202 6s. 6d. in payment of a dividend at the rate of 2½ per cent. per annum for the year, and to write off £121 5s. 8d., the balance, in reduction of £197 17s. 4d., the preliminary expenses.

In moving the adoption of the report, the Chairman explained that that was really the first annual meeting of the company since the works were opened, because they only took over the undertaking from Messrs. Edmundsons on July 1st last. They were extremely well satisfied with the reception the electric light had obtained in Winchester, and he predicted a still larger increase in customers, to meet which demand they had added another engine and dynamo set.

The report was adopted, and Mr. F. E. Gripper, the retiring director, re-elected.

Prospectus.—The London Trust Company, Limited, has this week been offering for subscription, at par, £100,000 5 per cent. second debenture stock, part of an authorised issue of £300,000 in the Edison & Swan United Electric Light Company. The reason for this issue was explained by Mr. Forbes at the recent meeting of the Ediswan Company reported in our columns. The list opened on Monday, and closed on Thursday, April 12th.

The Indo-European Telegraph Company, Limited.—The board, after adding £25,000 to the reserve fund, have determined, subject to audit, to recommend the payment of a dividend for the six months ended December 31st, 1899, of 17s. 6d. per share, making with the interim dividend already paid, 6 per cent., and a bonus of 20s. per share, both free of income-tax, making in all 10 per cent. for the year. The dividend and bonus will be payable on and after May 1st next.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending April 7th, 1900, were £206 6s. 0d.; receipts for corresponding period, 1899 (Easter Holidays), £602 10s. 10d.; aggregate for half-year to date, £2,278 18s. 5d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending April 6th, 1900, were £2,788 4s. 1d.; corresponding period, 1899 (Easter week) £3,557 16s. 10d.; decrease, £849 12s. 9d.

The City and South London Railway Company.—The receipts for the week ending April 8th, 1900, were £1,380; ditto April 9th, 1899, £976; increase, £404. Total receipts for half-year, 1900, to date, £17,319; corresponding period, 1899, £15,215; increase £2,104. Miles open April 8th, 1900, 3½; April 9th, 1899, 3¼.

The Dover Corporation Tramways.—The receipts for the week ending April 7th, 1900, were £160 0s. 9½d.; April 8th, 1899, £214 0s. 9d.; decrease, £53 19s. 11½d. Total receipts to date, 1900, £2,028 19s. 8d.; corresponding period, 1899, £2,109 19s. 9d. decrease, £81 0s. 1d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,948; 1899, 4,207. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, April 6th, 1900, were as follows:—D. U. T. Co., horse cars, £73 7s. 10d.; ditto, electric cars, £5,016 6s. 9d.; D. S. D. Co., electric cars, £1,753 6s. 1d.; total, £6,843 10s. 8d.; corresponding week last year—D. U. T. Co., horse cars, £2,134 14s. 4d.; ditto, electric cars, £1,268 7s. 10d.; D. S. D. Co., electric cars, £1,034 15s. 2d.; total (Easter week) £4,437 17s. 4d.; increase, £2,405 13s. 4d. Aggregate to date, £61,210 8s. 3d.; aggregate to date last year, £45,526 4s. 4d.; increase to date, £5,684 3s. 11d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending April 8th, 1900, amounted to £1,317; corresponding week last year, £1,674; decrease, £357. 1899 includes Easter Monday. Total increase in traffics for half-year to date, £755.

The South Staffordshire Tramways Company.—The receipts for the week ending April 6th, 1900, were £678 12s. 7d.; April 7th, 1899, £923 17s. 6d. Aggregate receipts for 14 weeks, £8,505 3s. 10d.; last year, £8,588 15s. 7d.

STOCKS AND SHARES.

Tuesday Evening.

With the holidays so close at hand, and general business showing no symptoms of improving until after Easter, a good many members of the Stock Exchange left town early in the week to start the recess. Their clients exhibited no disposition to grumble at their absence, and very few orders have been executed this week, for the best of all reasons. "After Easter" is looked forward to as the sure precursor of livelier times, but we seem to remember that similar hopes on the Stock Exchange have ere this come to nothing. While money remains so tight there is not likely to be any great demand for investment stocks and shares, and for the moment it appears probable that Lombard Street will keep up its rates for some time yet.

The electrical supply market has been characterised by irregularity. Chelsea Ordinary and Metropolitans have both been offered pretty freely, and City of London Preference are 10s. lower than when we wrote last, but Westminsters have enjoyed an active market and are fully ½ better. Under promise of their strict secrecy, we may tell our readers that the Westminster Electric is taking steps to increase its ordinary capital, but there is a difference on the board as to whether the £5 shares shall be issued at par to the ordinary shareholders, or at £10. A meeting is to be held to-morrow to consider the matter.

We are sorry to see that those outside brokers of Victoria Street, Messrs. Sims, Newman & Co., are again pushing the offer of Ordinary and Preference shares in the Hampstead Electric Supply Company, Limited. Both descriptions are unmarketable in the Stock Exchange, and it is no good advertisement for any company to have its shares hawked about by circularising outside brokers. The latter enclose with their letter a list of market quotations for the shares, which is as inaccurate as their puffs of the Hampstead Electric Company are out of place.

It is decidedly interesting to learn from the just published report of the Stock Exchange that during the past year the managers of that body spent £1,046 on the working expenses of the plant which supplies the House with the electric current. Repairs cost another £311 11s. 4d., and a new extension of the plant came to £1,828 odd. The Stock Exchange now makes its own electricity, and also supplies several of the adjacent buildings with the current.

London Electrics are a weak market, some of the shareholders selling apparently upon the meeting, when new capital outlay was foreshadowed. St. James's retain their rise of last week, and in the provincial section, Bournemouth and Poole are steady at 12, and Oxford Electric remain unchanged at 6⅝.

Babcock & Wilcox, after their dramatic rise last week, have fallen back from 60 to 52½. Our argument that the smallness of the yield would quite counteract the reconstruction proposals, has been adopted by the market, and several large shareholders were not slow to take advantage of the rise and to clear out of their holdings. In our opinion the present price is quite high enough. Other industrial shares are very quiet. A glance at our list on the next pages shows that hardly a single alteration has taken place. Crompton Debentures are a point better, and that is practically the sole change. Telegraph Manufacturing are better in tone, and a small buyer had to pay as much as 10⅜ for a few shares on Tuesday. India-Rubber and Gutta-Percha shares changed hands at 21⅜, but on the whole this department has remained very quiet. The fact that the Stock Exchange is closed from Good Friday to the following Tuesday morning quite stifled all speculation.

National Telephone shares keep dull on the progress now being made with the Government arrangements for providing telephonic facilities in the metropolis. No fall has taken place in the nominal price of the shares, but the market are far from "anxious buyers," as they say in the House.

The announcement that the District Railway would be shortly running a public trial train on the electric traction system failed to impart any strength to the Ordinary stock of the company. It now stands at 31, having been up to 32 and down to 28 during the present twelvemonths. Last year, however, the clique at one time worked the price up to 42⅜, partly upon rumours as to what electric traction would do for the line. It will be extremely interesting to note what difference the new system of haulage will make. Ordinary stockholders will watch the scheme with almost painful attention. They have been waiting for a dividend ever since the spring of 1882, 18 years ago.

Again have the Anglo-American Telegraph Company's stocks relapsed into somnolence, losing ½ per cent. before doing so. The "boom" in American rails, which assisted the quotations of Anglos to advance, is over for the time being, and now some of the bulls are profit snatching. Eastern Ordinary is weak, the actual price being no better than 153. That large line of stock to which we referred last week is still undigested, and investors have been too busy paying the calls on their Khaki scrip to attend to other markets. Great Northern Telegraph shares, however, found some supporters, but Western Telegraph have lost ½, and are now 14⅜ middle.

Mr. Shrimpton said about him.

After a few friendly criticisms had been offered by Dr. Fagan, Mr. Shrimpton replied on several matters. At the new works they starting the year with 17,834, and had installed 1,111 since, and he believed he would be near the mark in saying they would put in 500 lights a month for every month in the year.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation, April 4th.	Closing Quotation, April 10th.	Business done during week ended April 10th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	65 — 68	65 — 68	...	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	117 —118	116½—117½	117⅛	116⅝
3,062,240	Do. do. Deferred...	Stock	...	18s. %	£1 7s	15 — 15½	14½— 15	15 3/16	14⅝
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	...	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175 xd	165 —175	...	...
1,382,823£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	..	...	103 —105	102 —104	103½	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	1 %	...	⅜— ½	⅜— ½	...	...
16,000	Cuba Telegraph	10	7 %	8 %	...	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	19 — 20	19 — 20	...	...
12,981	Direct Spanish Telegraph	5	4 %	...	...	4 — 5 xd	4 — 5	...	...
5,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	101 —105%	101—105%	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	11½ — 12 xd	11½— 12	11 15/16	11¾
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	152 —157	152 —157	156	152
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	98 —101	98 —101	100½	99½
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	115 —120	115 —120	116½	116
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	16 — 16½	16 — 16½	16 7/16	16½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	100 —103	100 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	115 —120	115 —120	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	100½	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	...	...	...	101 —104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	5½ %	...	11½ — 12	11½ — 12	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15½ — 16	15½ — 16	15⅝	...
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	...	...	32 — 34	33 — 35	...	...
86,300	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	54 — 58	54 — 58	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	105 —108	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	5 — 5½	5 — 5½	5 3/16	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5½— 5¾	5½— 5¾	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½%	97 —100	97 —100	97½	97½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	102 —105	102 —105	...	...
11,889	Reuter's	8	5 %	...	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	126 —131	126 —131	...	...
58,000	United River Plate Telephone	5	5 %	6 %	6 %	4½— 5½	4½— 5½	...	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	4½— 5½	4½— 5½	...	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	%	...	...	97 —100	97 —100	99½	99
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	100 —104	100 —104	...	...
205,993	Western Telegraph, Ltd., Nos. 1—205,993	10	...	...	...	14½— 15½xd	14½— 15	14⅝	14⅜
75,000	Do. do. 5 % Debs. 2nd series, 1905 ...	100	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Telegraph	10	2%	...	...	¾— 1½	¾— 1½	1	...
34,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	9½— 9¾	9½— 9¾	9 9/16	9½
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	7 — 8	7 — 8	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	104 —107	104 —107	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	...	7 — 8 xd	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	...	...	8½— 9½	8½—9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9½— 10½	10⅛	10¼
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	6 %	6 %	6 %	7 — 8	6½— 7½	...	..
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	...	...	108 —111	108 —111	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	10 %	6 %	4 %	10 — 11	10 — 11	10⅜	9 13/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½— 13½	12 — 13	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	4 %	9½— 10¼xd	9½— 10½	10¼	10⅛
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12½— 13½	12½— 13½	13⅛	13
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	109 — 112	109 —112	110⅛	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5½	4½— 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 2½	1½— 2	1⅝	1½
48,050	Do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5 xd	4½— 4¾	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	14 — 15	13½— 14½	14½	14
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	...	...	114 —117	114 —117	...	...
125,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	96 — 98	96 — 98	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	14½ %	14½ %	14½ %	14½— 15½	14½— 15½	14 15/16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2½— 2¾	2½— 2¾	...	...
50,000	Do. Do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4 — 4½	4 — 4½	4½	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	12 %	12 %	13 %	14½— 15½	15 — 16	15 1/16	15

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation April 4th.	Closing Quotation April 10th	Business done week ended April 10th, 1900. Highest.	Lowest
65,000	Aluminium shares, Nos. 1—65,000	‡ 1	10 %	...	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101 xd	96 —101	...	...
80,000	British Electric Traction	10	...	6 %	...	17 — 18	17 — 18	17 1/16	17 1/16
80,000	Do. do. 6 % Cum. Pref. 80,001—60,000	10	...	...	...	12¾— 13¼	12¾— 13¼	13⅛	12¾
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127 xd	124 —127	...	...
45,000£	†British Electric Works Co., Ord. £1 shares, 50,001—95,000	...	...	...	...	⅞— 1	⅞— 1	...	...
50,000	† Do. do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	⅞— 1	⅞— 1	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	99 —101	99 —101	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	20 %	11 — 12	11 — 12	11⅜	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6 — 6¼	6 — 6¼	6⅜	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1¾— 2	1¾— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	2 1/16	2⅛
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	108 —113	108 —113	114½	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —105	103 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½ %	15 %	...	14½— 15½	14½— 15½	15 7/16	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —116	112 —116	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10¾	10¼— 10¾	10⅛	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4¾— 5¼	4¾— 5¼	...	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	...	...
855,000	City and South London Railway	Stock	1½ %	2½ %	1½ %	67 — 70	67 — 70	...	...
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000 ...	10	...	...	...	6 — 7	6 — 7	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3⅝	3 1/16
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	98 101	99 —102	101⅛	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	2 — 2½	2 — 2½	2⅛	2⅛
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	...	3½— 4½	3½— 4½	3¾	3¾
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	93 — 95	93 — 95	94⅜	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	2 1/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	...	2¾— 3⅛	2¾— 3⅛	3	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 11	10 — 11	...	...
80,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13¼— 14¼	13¼— 14¼	...	...
12,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼— 5¾	5¼— 5¾	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21⅜	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½ %	3½ %	3½ %	8⅝— 8⅞	8⅝ — 8⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13½	12⅞— 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40	36 — 40	36⅜	36¼
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ...	5	...	...	...	9¼— 10¼	9¼— 10¼	10 7/16	10⅛
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5¼— 5⅝xd	5¼— 5⅝	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	101 —104	101 —104	102⅝	102

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 105—108.
National Electric Free Wiring, 12/6 paid. 9—11.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17—18.
Do. do. Pref. (£10 pd.), 10½—11.
Smithfield Market Electric, 2—3.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7⅛. Debentures, 105—108. Dividend, 1899, on Ordinary Shares 11 %.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18.

Bank rate of discount 4 per cent. (January 25th, 1900).

MARKET QUOTATIONS, Tuesday, April 10th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	32/-	32/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) ..	per ton	£34	£34	..
a " " "	per ton	£31	£31	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£26 10	£26 10	..
a Lead, Nitrate	per ton	£25	£25	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	4½d.	4½d.	..
a " Caustic (75/80 %) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a " Crystals	per ton	£3	£3	..
a " Bichromate, casks ..	per lb.	3½d.	3½d.	..
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b " Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£80 to £150	£80 to £150	..
c Brass (rolled metal 3" to 12") basis	per lb.	8¼d.	8¼d.	..
c " Tube (brazed)	per lb.	10¼d.	10¼d.	..
c " " (solid drawn) ..	per lb.	9d.	9d.	..
c " Wire, basis	per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed)	per lb.	11½d.	11½d.	..
c " " (solid drawn) ..	per lb.	11½d.	11½d.	..
g Copper Bars (best selected) ..	per ton	£87 10 to £89	£89	dec.

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£87½ to £89	£89	dec.
g " Rod	per ton	£87½ to £89	£89	dec.
c " (Electrolytic), Bars ..	per ton	£85	£85	..
c " " Sheets..	per ton	£94	£94	..
c " " Rod ..	per ton	£88	£88	..
c " " H. C. wire	per lb.	10d.	10d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f " Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	8/-	8/-	..
h India-rubber, Para fine ..	per lb.	4/2½	4/4 to 4/4½	2d. dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants)	per ton	77/6	77/3	3d. inc.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i " Wire galvanised No. 8 ..	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£16 15	£16 17 6	2s. 6d. dec.
g " " Sheet	per ton	£18	£18	..
w Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 12 6	£9 12 6	..
d Mica (in original cases), small	per lb.	3d. to 9d.	3d. to 9d.	..
d " " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 12	£3 12	..
p Silicium Bronze Wire	per lb.	10½d. to 1/	10½d. to 1/-	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£140 to £141	£143 to £144 nom.	dec.
g " foil	per lb.	1/9	1/9	..
w " wire Nos. 1 to 16	per lb.	1,9	1/9	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	8½d.	8½d.	..
j " Best Flax, 6 lea. ..	per lb.	6d.	6d.	..
j " Hemp, 8 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j " " Russian, 10 lbs.	per lb.	5½d.	5½d.	..
j " Jute, 180 lbs. rove ..	per ton	£15	£15 10	10s. dec.
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£27 5 nett.	£27 5 nett.	..

Quotations supplied by
w Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Messrs. Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
n Messrs. W. T. Glover & Co., Ltd.
o Messrs. P. Ormiston & Sons.
p Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

ON AERIAL LOCOMOTION.*

By HENRY WILDE, F.R.S.

Various attempts have been made at different times to establish relations between gravity, electricity, and magnetism with the object principally of transporting bodies from one place to another through the air. The author referred to several of these endeavours, and described some experiments, made by himself some years ago, on the discharge and reactive force of elastic fluids when subjected to the influence of electricity and magnetism, as well as under ordinary conditions, with the same object in view. These experiments proved conclusively that the reactive force so produced cannot, under any circumstances, be utilised as an ascensional motive power in aerial locomotion. Science, however, profited by these researches, as the velocity with which air of atmospheric pressure rushes into a vacuum was determined, and other results of permanent value in the dynamics of elastic fluids were also obtained. The author described his experiments on the ascensional power of aerial screws, but the results obtained were not sufficiently promising to induce him to proceed far in this direction. His confidence, however, in the ultimate solution of the problem of aviation still remains unshaken. The fact that man has been able to transport himself through the air westward to Ireland, eastward to and from the Continent, and has reached a height of nearly seven miles above the surface of the earth, is sufficient encouragement to inspire inventors to further efforts till the object of their ambition is attained.

In a brief summary of the history of aerial navigation from the time of the invention of the aerial screw and of the parachute by Leonardo da Vinci in 1500, the author emphasised the fact that a flying machine has not yet been created sufficiently energetic to transport a man from one place to another as in ordinary balloon practice. It was also pointed out that the most recent experiments for navigating the air are mere repetitions of those already known, and manifest a strange disregard of the fundamental conditions which must be fulfilled before aviation can take rank with man's achievements in locomotion on land and on water. These conditions or criteria were summarised as follow:—(1) An aviating machine should have power to ascend and descend at any place and at any time under ordinary conditions of wind and weather; (2) it should be able to move in any direction or remain stationary above the earth; (3) the machine should contain within itself an automatic principle of safety by which in the event of any accident to a vital part of the mechanism, the descent would be effected without danger to the aviators. All the means so far devised for navigating the air fail to satisfy one or other of these essential conditions. Soaring aeroplanes fail conspicuously in all these criteria, partaking more of the character of projectiles or aerial torpedoes than of a means of locomotion. Mr. Hiram Maxim is disposed to view the result of his recent magnificent experiment in this light, and has even proposed that this apparatus shall be used as a military projectile.

None of the means so far devised from the time of Leonardo da Vinci is competent to solve the problem of aerial locomotion in accordance with the conditions above defined, and, with one exception, the category of possible solutions is exhausted. In the absence of the discovery of some new property of matter, the remaining method by which the problem may in the future be attacked, is to reverse the action of a parachute by a vibratory motion, produced by a motor of some kind, to cause the parachute to rise against the action of gravity, instead of using it solely for the purpose of descending towards the earth as heretofore. Several means were indicated by which this vibratory movement may be effected. When the power of ascension is once attained, travelling through the air in a horizontal direction is a comparatively minor problem, and may be brought about by inclining the vibratory parachute from the perpendicular in the direction of motion required by well-known mechanical means. The sustaining surface of the parachute would be sufficiently large to enable the aviators to descend with safety in the event of the sudden failure of the aviating mechanism.

The paper was illustrated by an interesting series of lantern slides, and evoked an animated discussion.

CONDENSATION NOTES.

A practical engineer, who has made a study of condensation, asks how it is that the vacuum obtained with a condensing engine will vary with the water supply. Thus, in one case coming under his notice, he found that as the state of the steam varied, so did the vacuum. This is, after all, probably easy of explanation, even though, at times, a variation of as much as 2 inches was observed, though 1 to 1½ inches was a more usual variation. A probable reason is the volume of gas dissolved in the water. No doubt, after a fall of rain, the water would contain a good deal of dissolved air, or there would at the same time be washed down-stream the contents of pools that had been some time stagnating, and would be charged with carbon dioxide. In this way the vacuum would be impaired. Our correspondent also informs us that he has noticed very marked differences in the amount of water dripping from cylinder cocks when the cylinder is lubricated from what drips when it is not lubricated.

In a greatly underloaded compound engine, at the low speed of 26 revolutions per minute, the condensation in the high pressure cylinder was so great that the cocks had to be left partly open. Without lubrication a wider opening was necessary, and the point was proved by repeated trials. The engine would be run for about 15 minutes, and then oil would be applied, with instant reduction of the drip. The indicator cards at the same time did not show any difference in the steam consumed. This is just where the trouble of cylinder condensation occurs. It is not apparent upon the indicator diagram, and cylinder condensation can only be traced upon the indicator card when the actual point of cut-off can be decided, and the waste or clearance volumes of the cylinder are known exactly, so that the curve of comparison can be drawn upon the diagram.

There can be little doubt that cylinder condensation is reduced by lubrication. The oil covers the interior of the cylinder with a protective film or varnish of less conductivity than the bare metal. The interchange of heat between the cylinder metal and the steam is reduced by the protecting film. Thus, without any apparent change of the diagrams obtained, the amount of steam used will vary considerably. Specially where condensation is considerable would there be no change in the indicator diagram, though the amount of condensation might vary considerably. This is because the steam that condenses during the admission is very largely re-evaporated on the exhaust stroke, and with a large receiver would not be very apparent in altering the pressure, though by careful all-round tests, we have no doubt, the difference would be found—perhaps in the greater temperature of the condenser discharge, which, if found, would point to the greater loss with the unlubricated cylinder.

The subject is one of considerable interest, and one to which engineers in charge might well pay attention. It is only by the careful observations of practical men that the steam engine can be perfected.

THE FUTURE OF ELECTRICAL SUPPLY.

Not long ago Mr. Westinghouse proposed to distribute gas to sub-stations in place of generating electricity at central stations, and transforming it at sub-stations.

In the *Engineering Magazine* an attempt is made by Mr. A. D. Adams to compare the cost and efficiency of the two systems. Taking first the central electrical steam-driven station, with high tension distribution and transformation, he finds that rotary converters and transformers have an efficiency of 90 and 95 per cent., and the line has, say, also 95 per cent., whence he derives $\cdot 90 \times \cdot 95 \times \cdot 95 = 80$ per cent. efficiency. The main generators must therefore have an output one-fourth greater than the kilowatts required. Taking the capacity of the rotary converters as 1·0, that of the transformers will be $\frac{10}{9}$ or 1·11, and of the main dynamos $1{\cdot}11 \div \cdot 95^2 = 1{\cdot}23$.

The total plant capacity is thus

$$1 + 1{\cdot}11 + 1{\cdot}23 = 3{\cdot}34 \text{ KW. to deliver 1 KW.}$$

The main and sub-station system thus calls for a plant capacity 3⅓ times the useful output, and also costly transmission lines. The 80 per cent. efficiency is the best showing that can be made with the system as a whole. Then there are storage batteries, but these may, for our author's purpose, be omitted from present considerations.

He now considers the gas engines. A gas engine and producer combined have an efficiency, such that 1 B.H.P.-hour can be produced for 1 lb. of fuel, and this is far better than the best performance of engine and boiler. A small plant of two gas engines of less than 100 H.P. each with producers has shown a result as low as 1·03 lbs. of small or buckwheat coal per I.H.P.-hour, as compared with probably 1·5 lbs. of coal per I.H.P. with the best large steam plants. The gas results are not mere isolated specimens. In large engines, indeed, as in a 320 H.P. engine, 1 I.H.P. has been obtained from ·81 lb. and 1 B.H.P. from 1·03 lbs. per hour.

A reduction of one-third the fuel is certainly an inducement to use gas in place of steam engines, and our author sees no corresponding disadvantage to offset the economy.

The first cost of a gas engine is about that of a compound engine and condenser, while feed heaters, boilers, &c., cost little less per unit than gas producers. We should incline to think they cost a good deal more. Labour will be no greater, and fuel, carriage, and water will be less. It is easy to see that before long the gas engine should displace the steam engine. In place of sub-stations with converters the gas engine and generator would occupy the sub-station, and occupy no more room than the present electrical plant.

This system would abolish the central power station, and would change it into a gas-producing station, or each sub-station might have its small gas producer plant. In this latter case, however, they would involve much more room, labour, and fuel transportation than the single station where all the gas would be produced and led by pipes to the sub-stations. Gas mains take the place of cables, in fact.

Allowing the sub-station dynamo an efficiency of 90 per cent, the gas engine need only develop 1·11 times the useful energy as against the 1·23 times of a main steam station. The labour item may be considered nearly the same at the gas sub-station as with the electrical sub-station, and there are no engines at the gas-producer station. Hence labour remains all round about equal. The total engine investment may be considered constant in each case. The peculiar features of each system are the transmission mains, cables, or gas pipes. Assume a 400-H.P. sub-station, and a distance of five miles to

* Abstract of a paper read before the Manchester Literary and Philosophical Society, April 3rd, 1900. Prof. Horace Lamb, M.A., F.R.S. (President), in the chair.

the main station or to the gas producer. Then the main generators will be 400 × 1·23 = 492 H.P. capacity. The transformers, 400 × 1·11 = 444 H.P. at £5 per H.P. for main generators, and £2 per H.P. for transformers, their combined cost will be £8 37 per H.P. of delivery capacity to the distribution lines. Voltage being taken as 6,600 at the generating points, and the line loss 5 per cent., the cable and a tile-way will cost £5 per H.P. delivery capacity. The total outlay for machinery and cables will be £13·4 per H.P. delivery capacity to the rotary converters at the sub-stations.

With gas engines to deliver 400 H.P., the engines must develop 444 H.P., and at 100 cubic feet of gas per B.H.P.-hour, the gas supply must be 44,400 cubic feet per hour at maximum load, unless there is some capacity of storage. A pipe to deliver this will cost £13·2 per B.H.P. delivered for distribution.

In neither case has the cost of laying been included, as it may be considered equal in both.

This large pipe cost would be reduced by employing better gas, which might be produced up to five times the capacity of the poor gas assumed. Comparing, however, the two systems, the first cost of the two is about the same, but the electrical plant has the less efficiency. The combined efficiency for generators, transformers, line and converters being 90 × ·95 × ·95 × ·90 = 73 per cent., whereas the gas main and sub-station dynamos have a combined efficiency of ·95 × ·90 = 85 per cent. Thus for equal cost the gas system delivers 1·16 times the energy, apart from the fact that the energy produced costs for fuel but two-thirds that of the steam-driven system. Apart, however, from this hopeful view of gas power, does not the fact appear very prominent that within quite considerable areas it should be very carefully considered whether the great expense of distribution of high tension systems, the outlay on transformers, converters, and sub-stations, is not so great that equally good results might be secured by the more liberal use of copper in the transmission lines? In one case there are running machines which are not worth much when worn out. In the other case there is a lot of copper that is worth its cost whenever it is wanted to be pulled out.

Moreover, the heavy outlay in copper might be obtained by loans at a small rate of interest, for the copper would be a permanent and tangible security. Such loans could not be secured on running machinery. The copper would be as good as consols. It is certain that there is much to be said against the system of distribution that trebles the total capacity of machinery, and that low tension and ample copper have not been sufficiently considered. We are not, of course, thinking of really long transmission lines, but of moderate distances to which high tension systems cannot be applied with the certainty of economy that can be assured on really long distance work.

ECONOMY OF MECHANICAL DRAUGHT.

Referring to Mr. A. L. Steavenson's article on this subject, it may be pointed out that he is at once wrong, according to our ideas, in his original assumptions. We will allow him the water consumption, and we may pass the 8 lbs. evaporation per pound of coal, but we really cannot pass the 300 cubic feet (24 22 lbs.) of air per pound of fuel. This is a rate for very ordinary chimney draught. Even Rankine allows down to 18 lbs. of air for assisted draught, and Mr. Longridge has secured as low as 14 lbs. with good chimney draught and thick fires. It may, then, be fairly assumed that with fans we can get as low as 16 lbs. of air, or two-thirds of Mr. Steavenson's figure. This would reduce the horse-power cost per boiler from the £72 he gives, to £48, or to a total of £432.

Surely, however, even this figure is excessive. We cannot admit that 1d. per horse-power-hour is a fair charge against fans. With coal at 12s. per ton the cost of 1 H.P.-hour, using, say, 3 lbs. of coal is not one-fifth of a penny. Allow even one half-penny, and the above £432 is brought down to £216.

As regards cost of chimney, if Mr. Steavenson will give us full particulars of a chimney that will give a good draught to nine full size Lancashire boilers, we should be pleased to publish the name of a builder who will build such a good and sufficient chimney for £1 300. Its area would be something like 50 square feet, and its height 200 feet at least. We do not accept Mr. Steavenson's price for the chimney. It would be more like £2,600 in ordinary cases, and the annual cost would be £260, or more than the cost of fan driving. Mr. Steavenson, however, omits two important items: one is the cost of fans to set against chimney cost; the other is the saving to be effected by fans, which work best with coldest gases, and the intention of fan draught is the saving of as much as possible of the waste heat which now goes up the chimney to the extent of from 12 to 25 per cent. of the total heat generated. We find from Mr. Steavenson's own figure of 8 lbs. evaporated per pound of fuel, that he sends nearly 47 per cent. of the fuel capacity up the chimney. We might have added that his allowance of 1 inch water gauge at the fan appears somewhat excessive, but we need not, perhaps, object to this as it implies the possibility of even thicker fires and less total air.

The economy to be got from a well designed fan draught is in first cost, and this is very important, when there is any doubt as to the future, in the reduction of the air passed through the fires and in the reduced final temperatures possible. This latter economy ought to be very much greater than the cost of fan driving. In this estimate we have included nothing for the elasticity and certainty of operation, nor for the reduction of the number of boilers and of the buildings that is rendered possible where sudden increase of load can be dealt with by adding to the draught, and not to the number of idle spares, waiting with banked fires for the fog which rarely comes, but may be always expected.

Quite apart from what we fully believe to be possible in the way of economy, we would add that even were no economy possible on the lines indicated, it would often be possible, by the use of fans in the initial stages of a power or lighting scheme, to await developments before undertaking the expense of an immovable stack, which it is so easy to build too small at the outset, ever after to be a constant charge in its ineffectiveness.

THE B.I.W. COMPANY'S STAFF DINNER.

This hardy annual was seen at its best at the Adelphi Hotel, Liverpool, on Friday evening last when the directors, staff and guests foregathered to the number of about 120. The repast was wholly enjoyable, the post-prandial orations were typical of the occasion, and the savage breast was soothed, or at least should have been, by both instrumental and vocal examples of the divine art.

After the usual loyal reference to "The Queen," to whose many virtues the chairman, Mr. W. Marriner Brigg, alluded in eloquent terms, the toast of the "Electrical Industry" was given by Mr. Thos. Parker, who considered it a fitting opportunity for treating the company to a dirge on the competition of American and Continental machinery. He alluded to the Liverpool Overhead Electric Railway, to a speech he delivered in 1892, and gracefully conceded that Lord Salisbury was a greater man than himself. Mr. Parker was unusually pessimistic, and attributed the backwardness of the industry to foolish legislation. He hoped, in conclusion, that we would catch up with our rivals on the other side of the Atlantic.

Mr. Ferranti responded, and in the course of an eloquent speech paid ample tribute to Mr. Parker's pioneer work, and to the prominent position he still occupies in the electro-technical industry. As to the present position of affairs he felt quite happy and comfortable. He also gave testimony to the go-ahead character of the B.I.W. Company in its determination to get the best thing in the cable business; he believed that no firm had gone farther ahead, and he sounded a note of warning that the future might develop more cable manufacturers than the users needed.

Alderman Snape, evidently an ardent lover of science and its teachers, next gave the toast of "The Visitors," which afforded Sir W. H. Preece the opportunity of giving the company one of his most telling speeches in reply.

Sir W. H. Preece's personal recollections are always edifying and amusing, but the exigencies of space will not allow us to give more than the bare statistics he volunteered on the growth and development of the company. In 1894 there were 70 men employed, and the staff numbered 10. Now the men totalled 1,600, and the staff 130. In 1894, 280 tons of lead and 230 tons of copper were utilised in the manufacture of cables; now the figures are respectively 7,500 and 6,000 tons, to which the speaker might have added two Ather tons, and the cable sent out at the present time amounts to 18,000 tons. The turnover of the company having increased 10 times within the period mentioned, was fairly indicative of the progress of the electrical industry which he considered to be in the best possible condition, and he differed wholly from Mr. Parker with regard to legislation having had any deterrent effect on electrical progress.

In acknowledging the toast of the "B.I.W. Co., Limited," Mr. J. B. Atherton soared to high flights of eloquence, and credited Sir W. H. Preece with being the best friend his company had ever known. Mr. Ferranti, he said, was engaged in trying to make a paper submarine cable at least four times more valuable than the best now across the herring pond. Probably this is the reason the Pacific Cable scheme is hanging fire; at all events, it does not seem to get beyond paper. In touching on free wiring the speaker said if the thing were better worked it would bring the electric light within reach of everybody, and he mentioned Prescot as an instance of its utility. He spoke of foreign competition in the cable business, with Glasgow as an example of the frontal attack of the stranger within our gates, but he hoped to carry out a turning movement, for he was convinced there was nothing better in the "main" than his company's wares. He concluded by expressing his delight at seeing so many there who had given him the company of their pleasure to dinner, a comical *lapsus linguæ* of which he seemed happily oblivious.

Mr. Nisbet, in proposing the health of "The Directors," found it difficult, after three years of the same toast, to say anything good or new of them. At the same time, he was careful to avoid anything bad. They were building a technical school in Prescot for the better education of their workmen, and they treated their staff well. The value of paper as nourishment was well exemplified in the rotund figure of his friend, Mr. Bates. It was easy to perceive from Mr. Nisbet's remarks that the staff have something to work for, and that in serving the best interests of their employers, they are also benefiting themselves in no small degree. This mutual regard of employers and employés for one another is as it should be, and has doubtless been one of the chief causes of the present prosperity of the B.I.W. Company. The chairman, in response, made another allusion to Sir W. H. Preece as the *fidus Achates* of the company, and thanked the many engineers present who had helped them to their large business by pluckily taking up what at one time was looked upon as a doubtful product.

In the final toast of "The Chairman," Mr. Jacob Atherton tried hard to outvie his brother, and honours may be said to have been fairly divided.

A great feature of the evening were the selections of the Euterpean (Ladies') Orchestra (which has had the honour of playing before the Prince of Wales), and of Mr. Josef Cantor's vocal quartet. Certainly the piquant, graceful overture to "Raymond," by Ambroise Thomas, one of the most famous of French musicians, passed without a sign of recognition, but when an excerpt from that immortal work of genius "The Dancing Girl" was being performed, the efforts of

the orchestra were quite eclipsed by the vocal talent of certain irrepressible young bloods in the assembled company. And yet it is said that England is not a musical nation!

Patriotism of the most fervid nature was also aroused during the performance of a "Nautical Selection," in which well known sea songs are introduced, but the "feeders" absolutely declined to be bound down to the time of the orchestra, so the general effect can be better imagined than described. An audible ejaculation of "Great Scott!" from the immediate neighbourhood of the editor of *Lightning*, caused us to examine more carefully our programme, when we found that the orchestra was almost wholly composed of the Scott family. And then that editor began to softly chortle, "Scott's wha' hae' wi' Atherton fed."

The vocal party was most excellent, and compared favourably with some of our metropolitan over-praised and *blasé* quartets. We have never heard a more beautiful alto voice, nor an alto with a more finished method; the bass was capital in voice and style, and the tenor was full of power and passion.

Altogether the evening from gastronomic, social, and musical points of view was quite enjoyable, and we congratulate the B.I.W. Company on a most successful gathering to celebrate a most successful financial year.

THE ELECTRIC LIGHTING OF ST. PETERSBURG.

(*Concluded from page* 563.)

Switchboard.

The switchboard at this station was made by Messrs. Cowans, Limited, of Salford, England.

On the left are 20 panels for machines; in the centre three for synchronising purposes, and on the right 20 feeder panels.

All contacts on these are made by flat-tongued plugs.

Each alternator panel has:—

1. A system of contacts for connecting the positive of the alternator with the main bus bar, with the spare bar, or the special coupling bar or synchroniser bar.

2. A single-pole high tension switch, actuated by an Andrews' discriminating release in case the alternator motors from any cause, for example, failure of excitation current, or machine breakdown.

Each feeder panel comprises:—

1. Contacts for connecting the positive of the feeder with the main bus bar, spare bar, or the special (or controller) bar, connected with the feeder regulator (or booster).

2. A single-pole switch and an automatic maximum cut-out, which switches out if the feeder carries 50 per cent. more than its normal load.

3. A 150-amperemeter.

The three centre panels carry the following apparatus:—

1. Three voltmeters giving each the volts on the main bus bar, spare ditto, and the synchroniser bar.

2. An amperemeter calibrated up to 2,000 amperes, and which gives the total output on the main bar.

3. For synchronising purposes there are two 100-volt incandescent lamps and voltmeters.

The lower section of the board forms a desk, on which are placed the exciter ammeters and rheostat hand wheels. The rheostats are fixed below the switchboard gallery in a room on the engine room floor, through which the feeders are also brought up to the back of the board; the booster is also in this room.

On the desk in front of the three centre panels is the signal transmitter between the switchboard attendant and the engines; this is in two sections, one for the engines on the left, and the other for those on the right; there are receivers for each of these signals at each engine, reading as follows:—Start up, parallel, full steam, less steam, all right, stop.

To put a feeder in service without disturbing the rest of the network, it is plugged on to the controller bar. The booster is a transformer of the rotary type with ratios variable from 1 to 0 and 1 to 1; one of the windings is connected to the main bus bar, or spare bar as required, the other to the feeder. By a movement of rotation of the shuttle through 180°, the two coils, which are first in opposition, are brought together by degrees, so that the feeder is charged little by little to 2,000 volts, and is then coupled direct to the main bus bar through the feeder switch.

It is also easy, by means of the spare bus bar, to put in a group of feeders with a machine, connected to the spare bar, the live feeders being connected to the main bar, the extra alternator then being synchronised.

The three public lighting feeders are separate, but can be synchronised on the main load. The lighting of the station itself is taken from these or from the private or main load.

The secondary circuits of the last named (station lighting) are controlled by a switchboard in the assistants' office, and consists simply of a voltmeter of 120 volts, a general ammeter and the switches and cut-outs for the different arc and incandescent circuits.

Network.—General Description.

Above has been shown the means of distribution which has been adopted; the primary side of the network has a tension of 2,000 volts, and with the transformers at each house service this is brought down to 110.

The whole of the network is composed of the feeders, distributors, and services. The feeders are brought from the station direct, giving current to a group of distributors, from which are tapped off the house services. The groups of distributors are normally isolated one from another, so that, if an accident happens to one group, it does not affect another part of the network. The switch pillars are placed at convenient intervals (practically at every street corner), so that any line can be cut out of or in circuit as wished.

Below is given a table showing briefly the development of the netwwork:—

	Feeders in kilometres.	Distributors in kilometres.
Cable laid from September 1st, 1898, to March 1st, 1899	15	44·3
Cable laid from March 1st, 1899, to October 15th, 1899	31	79·9
Total	46	124·2

Grand total, 170·2 kilometres.

To these are added the house services:—

	Number.	Length in kilometres.
Services laid before March 1st, 1899 ...	260	10
Services laid from March 1st, 1899, to October 15th, 1899	391	14·2
Total	651	24·2

Note.—Average size of transformer, 5 kw.

The grand total length of cable laid being 194·4 kilometres, of which 125·1 kilometres were laid between March 1st, 1899, and October 15th, 1899.

The feeders number 20 altogether, all having a section of 60 mm.^{2} (for each conductor), save two, these having 100 mm.^{2} and 50 mm.^{2} respectively. The section of distributors are 11, 15, 22, and 40 mm^2.

Cables.

The cable was manufactured by the Telegraph Manufacturing Company, Limited, of Helsby, near Warrington.

This cable does not only answer to the conditions which are ordinarily required for 2,000 volts, but were specially manufactured, because of the bad quality of the soil in St. Petersburg, which is very marshy indeed; and more, the fault on a cable during winter entails great labour, the ground being frozen hard a metre in depth, it being only possible to dig with a sledge hammer and spike.

All cables are concentric, of which the outer conductor is at zero potential.

Below is a description of the "Helsby" cable:—

1. The inner conductors, tinned, and having a high conductivity.

2. A layer of pure Para rubber, and on top of this two more layers of rubber, all three being vulcanised together.

3. The outer conductors insulated exactly the same as the inners.

4. Lead sheathing covered by jute soaked in a compound solution.

5. Two layers of steel armouring tape, wound both in the same direction.

6. On top of all another layer of prepared jute.

Each cable was tested before leaving the works, and gave a reading varying between 5,000 and 10,000 megohms per kilometre for the inner conductor, and between 2,500 and 5,000 megohms per kilometre for the outer conductor. The

cables were tested again after having been laid, and were found to have lost practically nothing in their insulation.

The cables were laid directly in the ground, in trenches 2 feet in depth, on top of which were placed bricks. At street crossings they were run through cast-iron pipes.

The joints are simple, both as regards the straight or T, the inner conductors are soldered together, the old insulation being thoroughly re-established, the vulcanizing being done by means of a benzine blow lamp. The joint between the outers is effected by means of the outer conductors being clamped between two discs of brass at each end of the joint box, for the purpose of facilitating the soldering. These discs are then joined together by a copper rod (straight or T, as the case may be), and firmly screwed up at each end. Compound is then poured into the box, after having been closed.

Switch Pillars.

These are 67 centimetres in height and 31 centimetres square, and are raised above the ground. A door is placed both at the front and back. These were also supplied by the Telegraph Manufacturing Company, Limited.

The cables are brought up from below, the outers (negative) being each fixed to a common uninsulated bus bar, placed about 15 cm. from the ground. Above this are five insulators, in which are mounted lugs and fuse contacts for receiving the inners of cables (positive), and their respective fuses. At the top of the pillar is an insulated bus bar, to which are bolted five copper fuse contacts. When a fuse (which is protected in a glass tube) makes connection from a cable (inner) to the highest bus bar, it supplies current to this, and if any other fuse is inserted, the cable to which it belongs receives current. As an additional precaution, glass plates are fixed vertically between upper and lower bus bars, effectually preventing any arc spreading if a fuse tube breaks.

For pulling out or putting in fuses, a specially insulated handle is arranged so that it fits into a niche both at the top and bottom of the fuse, and so avoids all danger.

THE PACIFIC AND CAPE-AUSTRALIA CABLES.

The question as to the relative values to the public of the two cable schemes which have recently occupied a certain amount of attention in the press and elsewhere, cannot be fully understood or appreciated without some knowledge of the conditions under which each of these projects has come into existence, and we propose, as briefly as possible, to put our readers in a position to judge for themselves by giving a short recapitulation of the history of each.

For many years it was felt in Australia and New Zealand, as well as by those in England who were interested in these Colonies, that the telegraph rates charged for intercommunication were excessive, that the service was none of the best, owing to the frequent interruptions to the cables and to the Australian landlines. The original cable to the north of Australia was laid in November, 1871, by the British Australian Telegraph Company, which in 1873 was absorbed in the Eastern Extension, China and Australasia Telegraph Company, during which change the capital of the new company was "watered" to a great extent. Owing to frequent interruptions it became necessary to duplicate the original Java-Port Darwin cable, which was done by the company in 1880, but only on the condition that to put their system into efficient working order the Australian Governments were to pay to the company, for a period of 20 years, the sum of £32,400 per annum.

The rate charged at that time was 10s. 8d. per word from London to Australia, and this rate was not reduced till July, 1886, when owing to the dimensions which were being assumed by the Pacific cable scheme, the rate was lowered to 9s. 4d. per word. In 1887, at the Colonial Conference held in London, it was shown that great advantage, not only commercial, but also strategic advantages, would be derived by uniting Australia with Canada by a cable across the Pacific which would not be subject to the danger of interruption in war time. At this Conference it was unanimously recommended that a survey of the Pacific route should be at once undertaken, preparatory to the laying of this cable. This survey was, however, executed in the most dilatory manner by the home authorities, and it was only completed last year, that is to say, 12 years after the Conference. This delay gave an opportunity to the opponents of the Pacific cable—an opportunity of which they were not slow to avail themselves—of spreading reports in Government documents and in the Press, of the fabulous depths which existed in the Pacific Ocean: 12,000 fathoms, according to Sir Charles Todd, Postmaster-General of South Australia. Such erroneous information could not fail to have an effect detrimental to the Pacific scheme, emanating as it did from an official source. An egregious estimate furnished by the English Post Office also had a serious effect in damaging the prospects of a cable across the Pacific. Fortunately, these myths were swept away in the evidence given before the Pacific Cable Committee in 1896, but in the interval they have served their purpose. From 1888 onward, at the Inter-Colonial Conferences held in Sydney, Adelaide, Brisbane, and Wellington, the Pacific scheme met with acceptance and support. This attitude of the Colonies had the effect of procuring for themselves a further reduction of rates to England, so that in May, 1891, the rate was reduced (under a guarantee in which the Colonies were to bear half the decrease of receipts due to the reduction) from 4s. 9d. to 4s. But to quote the words of the chairman of the Eastern Extension, China and Australasia Telegraph Company, who, in speaking of the 4s. rate, said: "This loss, however, proved to be much greater than the Governments anticipated, and they insisted on the tariff being raised in order to diminish such loss. The tariff was, therefore, increased to 4s. 9d. on January 1st, 1893."

In three years after the 4s. 9d. rate was fixed the Colonies found themselves free from the need of paying the guarantee, which in that period had amounted to £55,489 as the traffic had nearly doubled itself, and thus the company at the end of this period were receiving the same income as before the reduction, and the Australian Colonies had made an immense saving, and had been enabled to send double the former number of telegrams at about half the former cost. These results were clearly due to the prospective competition of a Pacific cable.

It was not till some three years after the evidence given before the Pacific Cable Committee in London, which proved that the scheme was quite practicable, that a joint agreement was arrived at between H.M. Government and the Governments of Canada and Australasia, who entered into a joint partnership to carry out the laying of the Pacific cable. Up till this point the Eastern Extension Company had been successful in lulling the Colonies into inaction by offering a reduction of rates, but it now became necessary for them to take stronger measures to quash the impending competition; this they did by adopting a portion of Sir Sandford Fleming's scheme, of which the Pacific cable is only a part, by offering to lay a cable from Australia to the Cape with a branch to India, but the old bad habit still clung to them, and to carry this Cape-Australia cable into effect they asked for subsidies amounting altogether to over £100,000 per annum.

A portion of the above total was to come from Australia in the shape of a continuance for 10 years of the annual subsidy of £32,400 paid by the Colonies, which lapses at the end of the current month. These subsidies being refused, a more insidious method of meeting competition has been resorted to. The company now offers an immediate reduction of rates to 4s. per word, with a prospective sliding scale reduction to 2s. 6d. per word; but we have already shown that the 4s. rate which they have selected, may be looked on as a barrier in the way of any further reduction on a sliding scale basis. The company further asked for rights to establish their own collecting and distributing offices and private land wires in the Colonies. The effect of this seems to be little understood, and in some of the Colonies the authorities look upon the proposal with favour. By such permission the company will gain the advantage of being enabled to give rebates, canvass for customers, and make contracts with the large commercial firms for dealing with their telegrams besides this, as is done in England; they will probably pocket the Australian terminal tax at present received by the Colonial Governments. They will also be enabled to claim for their own lines those telegrams handed in without any special

indication as to route, and in this way do much to damage the financial success of the Pacific cable. It has been clearly pointed out in Canada and elsewhere that the Colonies are co-partners in the Pacific scheme, and are thus debarred from making independent agreements to the disadvantage of those with whom they have associated themselves.

THE PRODUCTION OF LIGHT BY ELECTRICITY AND GAS.

By ED. C. de SEGUNDO, A.M.Inst.C.E.

(*Continued from page* 596.)

There is another point of view from which the question of relative cost can be looked at, namely, from the point of view of the degree to which one's requirements as regards illuminating *effect* are fulfilled. For most purposes light is required in a particular direction, and it is immaterial to what extent the illuminating power exists in other directions. This is usually effected by means of shades of various types, which are intended to direct or reflect the light upon the spot where it is most wanted. In other words, one concerns oneself with the candle-power in one particular direction to the exclusion of others. The Improved Electric Glow Lamp Company manufacture an electric glow lamp which fulfils this condition somewhat upon the searchlight principle. The lamp is more expensive than the ordinary type of incandescent lamp, but if the illuminating effect in the direction required only is taken into account, an effective candle-power can be obtained, according to Dr. Hopkinson's report at a mean consumption of 1·6 watts per candle over 1,000 hours. Upon this basis the cost would nearly approach that of gas lighting from flat flame burners, being about 11·5d. per 1,000 candle-hours, including cost of renewals.

Let us for a moment assume an efficiency for the ordinary 5-foot gas burner that even gas engineers could not find fault with, and upon similar assumptions for the performance of the incandescent electric lamp, work out the equivalent cost of producing 1,000 candle-hours by electricity, and then consider whether the cost thus arrived at is within the bounds of reasonable probability.

London gas may be taken to yield 3·3 candles per foot when burnt in an efficient type of flat flame burner. The consumption of 5 cubic feet per hour should, therefore, give 16·5 candle-hours.

We shall run no serious risk of contradiction from fair-minded gas engineers if we take 15 candles as the illuminating power of a 5-foot burner.

On this assumption, 1,000 cubic feet of gas should yield $\frac{1,000}{5} \times 15 = 3,000$ candle-hours at a cost of 12d. per 1,000 candle-hours, taking the average cost of gas at 3s. per 1,000 cubic feet.

A 16-c.p. incandescent electric lamp by any self-respecting maker will not consume more than 4·5 watts per candle during a useful life of 1,000 hours.

Thus 4,500 watt-hours will correspond to the production of 1,000 candle-hours.

In order to be on a par with the cost of gas, light for light, it should be possible to obtain 4,500 watt-hours for 12d., or at the rate of a little over 2 66d. per unit, from which, however, something should be deducted for the proportion of the cost of renewals per unit consumed in the lamp. This may be put at 0·2d. per unit for a 16-c.p. lamp, working at an efficiency of 4·5 watts per candle, making the equivalent cost of electrical energy 2·46d., or, say, 2·5d. per unit under these particular conditions. In this comparison we have also purposely left out of account any consideration of the many great advantages of electric light in our homes as compared with gas—advantages which are not merely sentimental, but which represent a real value in money.

It is not difficult to anticipate the gas engineer's comment. He will say that an obsolete form of gas burner has been taken, and that the comparison should be made between Welsbach incandescent burners and electric glow lamps. The Incandescent Gas Company claim that the Welsbach burner gives a light of 60 candles, as against 15 candles in the old system of gas lighting, or four times the candle-power for an equivalent consumpton of gas. These results do not, however, appear to be generally realised in practice. According to tests carried out by Prof. Carlton Lambert, the illuminating effect of the Welsbach burner when in perfect condition was 46·4 candles measured by the Pentane standard, and the falling off in the light emitted has been found in some cases to be very rapid. Of course there are mantles *and* mantles, and it would not be fair to generalise from the behaviour of individual mantles, but photometric tests carried out by the gas examiner to the County Council, and the experience of users of the Welsbach burner who are concerned with the determination if the degree of constancy of the illuminating effect show that the diminution of candle-power emitted with time is serious. Further, the Welsbach, like the electric glow, is extremely sensitive to variations in the pressure of supply, and while electric supply companies are improving every day in the constancy of pressure of supply, the same cannot be said of gas supply, as it is often impossible to maintain a constant gas pressure at all points throughout the area of supply, though, owing to the facility with which the gas pressure at the ordinary burner can be regulated by means of the tap, no serious inconvenience has been felt from this cause. Again, no pains have been taken in running gas piping in a house to ensure equal pressure at each burner whether all the burners are lighted, or only a portion of them; hence to ensure the best results with the Welsbach a governor is necessary, and attention has to be given to cleaning so that the air supply, as determined by the construction of the burner, should not be interfered with. The effect of restriction of air supply can be easily demonstrated by placing a finger on one of the air holes in a Welsbach burner; the diminution in the illuminating effect caused thereby being visible to the eye.

From the results of experience it may be fairly assumed that the average life of a mantle in domestic use is 400 hours, and that the average candle-power emitted during this period is 40 with a consumption of 3·4 cubic feet. Thus $400 \times 40 = 16,000$ candle-hours are obtained at a cost of

$$\frac{400 \times 3{\cdot}4 \text{ cubic feet of gas per hour} \times 36\text{d. per } 1,000}{1,000} + \text{cost of mantle}$$

$= 48\ 96 + 12\text{d.} =$ say 61d. or $\frac{61}{16} = 3{\cdot}8$d. per 1,000 candle-hours including renewals.

From the calculations made above it will be seen that the expenditure of 4,500 watt-hours are taken to correspond to the production of 1,000 candle-hours; hence if 1,000 candle-hours be produced by the incandescent gas light for 3·8d., including renewals, it would be necessary for electrical energy to be obtainable at $\frac{3\ 8}{4{\cdot}5}$ less $\frac{1}{8}$d. for renewals, or under $\frac{3}{4}$d. per unit in order to compete in the form of glow lighting on the basis of light for light.

It may fairly be said, however, that the glow lamp is hardly the right form of electric light to set against the Welsbach, firstly, because except in large rooms the Welsbach is not a suitable light. For most domestic purposes a general or distributed light is required, and not so much units of large candle-power. Moreover, owing to the character of the Welsbach light, it cannot be said that one Welsbach giving, say, 40 candles is equivalent in illuminating effect to four electric glow lamps giving 10 each. For some purposes it may be superior, but in general it would not be considered so satisfactory for room lighting, and owing to the intense and concentrated light emitted by the incandescent mantle, a Welbach light is always enclosed in some form of shade which absorbs a good deal of light. Then the manner in which the light is produced is not analogous to that in which an electric incandescent lamp gives forth its light. In the case of the Welsbach, gas is burnt at the point at which light is given off, and of necessity the products of combustion in the shape of CO_2, and other gases must pass into the room, whereas nothing is burnt or consumed in the electric glow lamp. This is a very important difference, and while, of course, the degree to which products of combustion

of gas make themselves felt depends upon the extent to which the purification of the gas is carried out at the gasworks, it will be conceded that the decorations of a room always suffer more of less where the illuminant is gas, as compared with electricity.

A form of electric light, with which is more comparable with the incandescent gas light, is the Nernst lamp in which a special form of filament is used differing from that of the glow lamp, and not calling for any envelope. Here the consumpton of electrical energy per 1,000 candle-hours is 1,500 watt-hours, and the cost of renewals practically nothing. In this case electrical energy supplied at $\frac{3{\cdot}8}{1{\cdot}5}$ = say 2½d. per unit would bring the cost, light for light, down to that of incandescent gas.

The comparison of the cost of gas lighting and electric lighting for streets and large spaces, whether open or closed, is more favourable to electric light at the present time. I say "at present" because those interested in the welfare of gas are keenly alive to the fact that while domestic electric lighting is still to a certain extent a luxury when viewed purely from a money point of view, the electric arc light is a very formidable competitor in the field of public lighting. There can be no question as to the very appreciable saving effected in the consumption of gas for street lighting when incandescent burners are used in the place of the ordinary burner for equal amount of illumination, but as compared with arc lighting even on the basis of light for light, electricity is cheaper. One thousand candle-hours can be produced by the arc light at an expenditure of 500 watt-hours, namely, for 3d. (electrical energy being taken at 6d. per unit), which compares favourably with 3·8d. per 1,000 candle-hours as calculated for incandescent gas lighting, but most electric supply companies charge 4d. per unit and under for electrical energy for public lighting which would be equivalent to 2d. per 1,000 candle-hours.

The actual cost of electricity or gas consumed per unit illumination is only part of the expense of lighting. In order to really compare the two systems of public lighting due regard must be had to the items of labour in cleaning and cost of renewals.

The cost of carbons for arc lamps is about ½d. per 1,000 candle-hours, the cost of mantles, assuming the life to be 400 hours on the average, would be $\frac{10\text{d.}}{16{,}000 \text{ candle-hours}}$, or ⅝d. per 1,000 candle-hours.

The cost of labour for arc lighting may be greater than that for incandescent gas lighting, and it would appear from the results of extended experience that the total cost per year of arc lighting is less than that for incandescent gas light for light.

(*To be continued.*)

REVIEWS.

"*The Practical Engineer*" *Electrical Pocket-Book for 1900.* Manchester: The Technical Publishing Company, Limited.

This is the first issue of the above publication, and might, therefore, be expected to contain a large proportion of typographical and other errors; a careful examination of the contents, however, reveals but few, and those of small moment. The index is hardly so full as might be desired, consisting of barely a dozen pages, though these are conveniently arranged all on one side of the paper. Like most compilations of this kind, the book begins with standard tables, mathematical constants, &c. We note that the "knot" is mis-named a "nautical mile," whereas it is the nautical unit of speed—one mile per hour; the standard litre measure is said to be a cylindrical brass vessel at the temperature of 0° C., containing one kilogramme of distilled water at 4° C., but how these temperatures can co-exist is not stated. A neat arrangement is adopted for circumference tables, but these, as well as the tables of areas of circles, are unfortunately confined to binary sub-divisions; they should be supplemented by similar tables in decimal form.

Passing on to purely electrical data, we find the usual haziness as to power and energy characteristic of "practical" engineers; the joule is said to be the energy expended *on work done* in a circuit, when 1 watt is being developed *per second* (p. 51); a watt-hour is called a watt per hour (p. 52); and a watt is made equal to 44¼ foot-pounds (p. 53). Mistakes of this kind are as inexcusable as they are common; the misuse of the word "watt-meter" for "watt-hour-meter" is equally objectionable, but this error is *not* made in the book under consideration. The temperature coefficient for copper is given as 0·215 per cent. per degree Fah.; we should prefer to see a more up-to-date value mentioned for this important constant, for example, that recommended by the Committee on Copper Conductors, 0·00238. A useful table of conductors is reproduced from a well-known maker's list, arranged in the common-sense order of increasing areas, instead of overlapping groups of 7's, 19's, &c. A neat system of wiring calculation, due to Mr. J. Sayers, is explained, in terms of feet per ohm.

On p. 73 the three-wire system has dropped out of its proper section into methods of wiring, among tree and distribution board systems, and is incorrectly described as affording an economy of 35 per cent. of copper, whereas it really saves 70 per cent.

The insulating conduit system of wiring is dealt with at some length, and the use of a bare conductor inside an insulating tube, surrounded by the earthed return conductor, is spoken of as affording a prospect of meeting ordinary gas-pipe construction on a directly competitive price basis. This view is somewhat unduly optimistic, seeing that the cost of steel *versus* iron, and of the insulating tube and copper conductor, are all extras on the gas-pipe work, to say nothing of slow bends, inspection boxes, &c.

The section on testing is well arranged, commendably brief and practical. Among electricity meters the old form of Aron meter is described, without reference to the great improvements effected in this instrument. A capital section on magnetism is given; the watt is, however, substituted for the joule in the hysteresis formulæ on p. 116. Under dynamos, the magnetic pull between two opposing surfaces is given in terms of their area, where, in the case of cylinders, the projected area should be used (p. 126). A table of leakage coefficients appears to have dropped off p. 129. The dynamo described by the Drs. Hopkinson in their classic Royal Society paper is used as an example of detailed calculations, but, of course, cannot be treated very fully in the space available for it; a discrepancy of 20 ampere-turns in 3,000 odd between the calculated and actual results is spoken of as a "margin for regulation"—a sufficiently amusing view of the range of regulation desirable. In the wire table in this section values are given for cotton covering for wires down to No. 30 S.W.G., the thickness of the covering being equal to or greater than that of the wire in the smaller sizes. These should be dimensioned with silk covering. Numerous particulars are given concerning bearings, shafts, belts, ropes, &c. A paragraph on fly-ropes for travelling cranes is rather out of place in an electrical pocket-book, seeing that electricity is an infinitely better motive agent for these machines.

A slight confusion occurs on p. 182, where it is stated that to compensate for capacity in an alternating current circuit, an E.M.F. leading the impressed E.M.F. by a quarter of a period must be added to the circuit. This should be an E.M.F. *lagging* a quarter period behind the *effective* E.M.F. By the way, the word "effective" is used for "virtual" on p. 184. Under transformers (p. 191) a formula for eddy current losses in wrought-iron is given, but, as is commonly the case, the temperature correction, which greatly reduces the loss, is omitted. This is, perhaps, unimportant, considering the independent way in which eddy losses differ from what, by calculation, they *ought* to be.

In a table of results of electric cranes a column is headed "weight" which apparently refers to height. Under arc lamps, the rate of consumption of carbon given applies to enclosed arcs, though this is not stated.

The pocket-book winds up with a diary on sectional paper, combining the advantages of both features; we are rather dubious, however, as to the necessity of the diary. How many who possess the book make use of this?

The book, as a whole, is very complete, dealing with almost all ordinary applications of electricity, and we look upon it as a decided gain to the field of electrical hand-

books; it is a worthy successor to the well-known pocket-book to which it forms a companion, while its low price places it within the reach of all. We have no doubt but that it will be kept up to date, and will annually grow in value and completeness.

In conclusion, we may express a hope that in future editions the book will be made to open in the ordinary way. We have used table books of both kinds for years, and we by far prefer those which are bound like other books.

Indicator Diagrams. By W. W. F. Pullen. Manchester: The Scientific Publishing Company. 1899.

This is a book that might better have been entitled the mechanics of the indicator. It contains descriptions and illustrations of most well-known instruments, and the number of these has much increased during late years. Reducing gears are also well described. The author speaks well of the Simplex instrument, which has a sort of sugar-tongs spring entirely outside the cylinder, and hence unaffected by the steam temperature to any serious extent. Only two continuous indicators are described, those of Blaisdell and of Little, nor do we see any description of the instrument with paper ribbon for experimental work. As to the Blaisdell instrument, so far as we can understand the description and illustration, it is practically identical with the first instrument invented by Ashton, but which Ashton superseded with his hyperboloidal instrument, because of the uneven wear of the disc of the integrating movement, which will be found the same in Blaisdell's re-invention.

The major part of the book is taken up with every manner of indicator diagram, chiefly faulty ones, for the purpose of pointing out the causes thereof. The detent gear shown on the Simplex indicator, for the purpose of holding still the drum, thereby saving the necessity of unhooking the cord, is an attachment which ought to be more generally used; we have found it most useful. American indicators do not possess it, but it would be an invaluable attachment.

There is a chapter on setting valves by the indicator. We fully agree with the author when he says that valves ought to be so set, but we will go further, and say they ought to be so designed that they can be set while the engine is running. There are sections on diagrams from water pumps, air pumps, and a chapter on gas and oil engine diagrams, and various miscellaneous items. The volume closes with tables of steam properties and other figures.

Young students of the steam engine and its mechanism will find this book very useful to them. It sticks to its one subject throughout—the indicator—and does not branch out into questions of thermo-dynamics. It is a special work on a special instrument, and keeps to its text.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. Thompson & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

5,609. "An improvement in electrical (static) transformers and in the arrangement of sub-stations containing them." T. Tomlinson. Dated March 26th.

5,649. "Improvements in and relating to telegraphic apparatus." S. G. Brown. Dated March 26th.

5,650. "Improved method and apparatus for determining the size and position of bodies by means of Röntgen rays." W. P. Thompson. (The Voltohm Electrical Company, Limited.) Dated March 26th.

5,693. "Improvements in and relating to telephonic systems." M. C. Mengis and F. S. Christensen. Dated March 27th. (Complete.)

5,698. "Improvements in the method of, and means for, protecting electrical connections." J. Langton. Dated March 27th. (Complete.)

5,707. "Improvements in means for carrying or supporting electric leads or conductors." S. Wolf. Dated March 27th.

5,710. "Improved indicator for storage batteries." P. J. S. Tiddeman. Dated March 27th.

5,727. "Improvements in the electric heating of liquids and apparatus therefor." J. A. G. Trudeau. Dated March 27th. (Complete.)

5,751. "Improvements in or in connection with storage batteries." E. A. Sperry. Dated March 27th. (Complete.)

5,755. "Improvements in the manfacture of electrical insulating material." C. Jung, A. Brecher, and A. Kittel. Dated March 27th. (Complete.)

5,773. "Improvements in automatic and safety subsidiary devices for controlling electrically propelled vehicles and the like." A. G. New. Dated March 28th.

5,786. "Improvements in electric cables." G. H. Nisbett. Dated March 28th.

5,806. "Improvements in the regulation of dynamo-electric machines." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated March 28th. (Complete.)

5,833. "Improvements in and relating to starting, regulating, and reversing switches for electric motors." G. A. Mower. Dated March 28th.

5,841. "Improvements in electricity meters." M. C. Clutterbuck. Dated March 28th.

5,848. "Improvements in conduits for electric tramways." M. H. Smith. Dated March 29th. (Complete.)

5,860. "Improvements in electrical apparatus for hoisting or other intermittent work." W. H. Scott. Dated March 29th.

5,900. "A method of securing intermittent motion in electric switches and other devices." C. B. Callow and H. J. Eck. Dated March 29th.

5,925. "An electric lift controller." J. G. Childs. Dated March 29th.

5,928. "Improvements in telephone divided multiple board systems." W. Aitken. Dated March 30th.

5,944. "Improvements in train lighting by electricity." B. J. Day. Dated March 30th.

5,961. "Improvements in and relating to the rendering watertight the attachment of fittings used in electric wiring to branch cables." W. McAulay, G. A. Clark, and J. A. McLaren. Dated March 30th.

5,980. "An improved plug and socket fitting for electrical circuits." H. Bevis and F. W. M. Chapman. Dated March 30th.

6,023. "Improvements in electric bells." The British Electric Works Company, Limited, and B. Brander. Dated March 31st. (Complete.)

6,028. "Improvements in brush-holders for dynamo-electric machines." E. W. Mix. Dated March 31st. (Complete.)

6,054. "Improvements in telegraph poles." H. C. Jobson. Dated March 31st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

15,838. "Improvements in or pertaining to multiplex printing telegraph system." P. M. Justice. (H. A. Rowland.) Dated July 3rd, 1897. Relates to printing-telegraph system with a multiplex distributor working with alternating currents. Each complete signal consists of the modification, by inversion or omission, of two or more semi-cycles of the alternations of the current. The alternating impulses may be derived from any suitable source. The alternations are divided up into cycles of predetermined number, and every complete signal of the code adopted is complete within a cycle. Each transmitting station is provided with a number of branches corresponding to the number of elements of the cycles, and these branches are connected to a distributor by which the signals are transmitted to line. Various arrangements of these circuits are described, the preferable arrangement being that in which the makes and breaks occur in local circuits and affect the alternating currents of the main line through a relay, the distributing action at the receiving station being also accomplished by means of a relay and distributor, the local circuits of which contain the requisite number of combination relays. The transmission may take place either by means of a perforated tape with one or several rows of perforations, or by a keyboard in which all the key levers operate a number of contact levers in the predetermined combinations. In this instrument a locking lever is provided for preventing the depression of a second key before the signal of a previous key is completed. 52 claims.

15,850. "Improvements in certain apparatus to be employed in connection with the electro-deposition of metals." J. B. Brookes and J. Holt. Dated July 3rd, 1897. This invention relates to the plating of small articles contained in a rotating barrel, and consists essentially in insulating the bearings of the barrel. In the arrangement described a cell contains the anode plates hanging from a rod connected to the lead, the electrolyte and the perforated rotating barrel, within which the articles to be plates are put. This is carried by bearing sleeves from hangers and is driven by a band. The bearings are mounted on wooden ends. A helical conductor or cathode has one end embedded in an insulating composition in one journal, while its other end passes into a metal sleeve into which also passes an uncovered extension of the insulated conductor, which enters the barrel through insulating material, placed in a hollow of the journal. In this case, the cathode rotates with the barrel, and the conductor is formed into a coil, and then passes in an inclined direction to a terminal placed above the liquid, working in a suspended bearing and making contact with brushes or contact plates forming the collection of a frame connected to the lead. Instead of the flexible shaft shown, a universally-jointed shaft may be employed, having any known modification of Hooke's joint. In one form, the parts of the insulated shaft are connected by the ends being formed as blades at right angles to each other, and by the blades entering annular cross channels in a sphere or ball placed between such ends. In a modification the helical cathode is secured to the hangers so that it shall not rotate with the barrel, in which case the return conductor is also a fixture. The cathode may consist of a series of metal bars arranged along the inner sides of the barrel so as to form a frame, the ends terminating in cross frames connected to the return conductor as first described. The provisional specification states that the cathodes are of the same metal as the anodes, and are afterwards used as such, or are melted down. 3 claims.

15,876. "Improvements in writing telegraphs." P. A. Newton. (L. G. McPherson.) Dated July 3rd, 1897. Relates to improvements in the class of apparatus described in Specification No. 17,965, A.D. 1891, No. 2,696, A.D. 1893, and No. 10,171, A.D. 1894. The arrangements of contacts and circuits are shown on diagrams which are too complicated for the purpose of abridgment. 25 claims.

15,877. "Improved means for feeding electricity to railway and similar vehicles." Dr. L. Cerebotani and C. Moradelli. Dated July 3rd, 1897. Relates to electric railways and tramways with sectional conductors and switches operated by electro-magnets on the vehicle. The rails are in insulated lengths, from which current is taken by the wheels and brushes. Magnets with long pole-pieces are carried under the vehicle, and, on being excited from a battery, pick up armatures in enclosed switch boxes, and connect the positive and negative conductors with the rail sections. 1 claim.

15,879. "Improvements in and relating to plates for secondary batteries." W. J. S. Barker-Starkey. Dated July 3rd, 1897. In the manufacture of plates or electrodes, they are first subjected to a current of electricity while immersed in dilute sulphuric acid, and then dries in the air, these processes being repeated as often as necessary. 2 claims.

15,903. "Improvements in or connected with electric batteries." A. D. Seton and J. L. Dobell. Dated July 3rd, 1897. Relates to batteries in which the electrical energy is obtained by the consumption or combustion of carbon or carbonaceous materials. The cell, preferably of iron, is mounted on a furnace and contains bismuth, or a combination of bismuth and lead, kept in a molten state by the furnace. The carbonaceous matter, which may be pieces of carbon, producer gas, or hydrocarbon vapours is fed into the molten metal through tubes, and is oxidised by the reduction of arsenates, arsenites, vanadates, chromates (except when lead is employed in the outer cell) manganates, plumbates, zincates, or a mixture of them contained in a porous vessel, preferably specially constructed of magnesite, and the salts are reoxidised by air

or oxygen forced in through the pipe, which also serves as one of the connections of the battery. A tube is provided for the exit of carbonic acid gas. Reference is made to Specification No. 4,442, A.D. 1897. 3 claims.

15,833. "Improvements in and relating to portable electric lamps." W. Mills. Dated July 5th. 1897. The invention consists of a portable electric incandescent lamp particularly adapted for bicycles and the like, and of a primary battery for use therewith. Two cells are preferably employed, united together by a band to which is fixed a socket for attaching the lamp to a bicycle, and having screws which hold in place between the two cells a rubber block, to the front face of which is secured another rubber block. Each cell comprises an external casing, in which is screwed a hollow plug serving as a reservior for a supply of the electrolyte and closed by a screwed disc carrying a plug, which, by moving the disc, can be made to open or close the exit from the reservoir. Gas exits are closed by a porous sealing, which is preferably a mixture of carbon and manganese peroxide. The carbon electrode is in the form of a hollow cylinder with internal longitudinal corrugations and cemented to the bottom of the cell, and the zinc electrode is secured to the same by the screw. The lamp may be screwed into a flange on a plate, and the reflector is screwed on to the same flange. The plate is held between the blocks, which is connected by a wire battery. The other pole is connected by a wire with a switch consisting of a rod which is pivoted on a screw, and the upper edge of which is provided with a triangular portion which can be forced between the head of the screw and the free end of a spring, which latter makes contact with the lamp. In a modification. the switch is dispensed with, and the second contact is made and broken by screwing inwards or outwards the reflector in which is fixed the lamp, so that the latter bears against or is removed from a fixed contact connected with the batttery. 22 claims.

16,054. "Improvements in electric controllers." The British Thomson-Houston Company, Limited. (A. F. Macdonald.) Dated July 6th, 1897. The controller is arranged so that by a vertical movement of the cylinder it may connect the motors in series or parallel, or may connect the machines to act as generators to supply current for braking purposes. Further, in order to save space some of the contacts are fitted within the cylinder. A cylinder is fitted with contacts of suitable grouping which engage with fixed brushes. These brushes are so arranged and so connected with a reversing switch that on raising the cylinder, as by the handle and cam, the desired re-arrangement of circuit is made. 9 claims.

16,065. "Improvements in incandescent electric lamps." F. Gabriel and H. Angenault. Dated July 6th, 1897. Relates to incandescent electric lamps. The leading-in wires and joints are surrounded by tubes of glass or other vitrified substance to prevent discharges between them. The invention is specially applicable to high voltage lamps. 1 claim.

16,068. "Improvements relating to the construction of rails for electric railways and bonds therefor." S. H. Harrington. Dated July 6th, 1897. Rail bond-rails. In order to increase the area of contact between the rail and the bond either or both of the following means are adopted. The rail is thickened locally in the web or elsewhere by a continuous rib or by bosses such where the bond is attached. The hole for receiving the bond is bored diagonally. 4 claims.

16,069. "Improvements in electric batteries." L. W. Pullen. Dated July 6th, 1897. The electrode is made up of a mixture of finely powdered amorphous carbon, such as graphite or plumbago, and a compound of manganese, preferably the peroxide, the whole being made into a thick paste with concentrated sulphuric acid. A sealed battery is described in which the paste above described has a conducting rod fixed in it, also a porous cell, and a zinc electrode immersed in dilute sulphuric acid. This battery acts first as a primary battery, and after its discharge it is charged again in the manner of an ordinary secondary battery. 3 claims.

16,139. "Method and apparatus for electrical signalling by means of split or divided currents, more particularly applicable to cable transmission." C. D. Abel. (La Societe Industrielle des Telephones.) Dated July 7th, 1897. Consists of a system of signalling for automatic, Morse, or submarine work, in which the cable is connected to the secondary or secondaries of a transformer or transformers and with a relay if necessary in the transmitting circuit. The local circuits may be either for single or double key or for automatic working, and are connected to the primary or primaries of the transformer or transformers so that the induced signalling current is followed on breaking the circuit by an inverse clearing current. A double key is connected to a transformer having a double primary coil, the two coils being in series. The transformer is provided with "parasitic" coils on screens which form closed circuits between the various coils. The core may be in the form of a ring and have primary, secondary, and "parasitic" coils on two parts, or it may be straight. The relay described has flat narrow coils close together and a pivoted armature facing the magnets and playing between adjustable stops. 4 claims.

16,220. "Improvements in electrically illuminated signs, advertising media, or the like." W. T. Bell. Dated July 8th, 1897. Relates to electrically illuminated signs, &c., in which groups of incandescent lamps arranged to form words or other devices are successively illuminated and extinguished. Each lamp is independently connected with the main circuit through a switch, and the pushes of the switches are arranged beneath a jacquard cylinder, over which passes the chain of pattern cards, and which is reciprocated vertically by cam and spring mechanism, the cylinder being rotated through a quarter of a revolution after each reciprocating by means of a lever system. The depression of a push is preferably caused to operate a toothed wheel through one tooth, and the toothed wheel in turn is caused to operate switch mechanism arranged to open and close the lamp circuit at each alternate tooth. In this case two depressions of the jacquard cylinder are necessary for each word or device, one to switch the lamps "on" and the other to switch them "off." To allow for this, pairs of corresponding pattern cards may be employed, or the card cylinder may be operated in such a manner as to bring a fresh card into position at each alternate movement. 7 claims.

16,304. "Improvements in electric tumbler switches." H. C. Gover and C. F. Proctor. Dated July 9th, 1897. Relates to tumbler switches, which are arranged to give a considerable distance between the conducting parts when the circuit is open. A two-way switch is described, in which the tumbler has a toothed segment gearing with a pinion on a spindle which carries the contact blades. The circuit is broken, on moving the tumbler to the right or the left the blades are thrown over to engage with the fixed contacts. A four-faced cam embraced by a spring is fitted on the spindle to hold the contact in either of the desired positions. Insulating locks or protuberances may be fitted on the base between the contacts. One-way switches may also be arranged to be operated by a toothed tumbler engaging a pinion as above. 2 claims.

16,339. "Improvements in dynamo-electric machines." G. Cheffey-James and H. P. Ward. Dated July 10th, 1897. In a dynamo, motor, or moter-generator, the coils generating the magnetic field are wound on bobbins or frames, so as to enclose the armature, and these coils are themselves enclosed by the fixed magnetic parts of the field magnets, which are extended at the sides so as to make the machine armour-clad. The positions of the magnetic parts of the field magnets and armatures are coincident with the lines of force generated by the coils. The invention may also be applied to the construction of four-pole or multipolar machines. It may also be applied to existing machines by continuing the field magnet coils on to suitable frames or bobbins enclosing the armature. 3 claims.

16,113. "Improvements in or relating to winding apparatus for field telephone wires or the like." L. Boije. Dated August 3rd, 1897. A reel is mounted on an axle and can be rotated by a crank handle. The reel and axle are enclosed in a case provided with two terminal screws, one of which is insulated. The axle has a gear wheel connected to a second wheel by an endless chain. The second wheel is mounted on an axle having a right and left handed worm in which a guide fits. The guide slides on a shaft and carries rollers which receive between them the cable to be taken up or paid out. Externally to the cable opening in the case brushes are placed so as to remove any dirt. In the case of single cables one terminal is connected to earth; in double cables both terminals are connected to line. 1 claim.

16,118. "Improvements in plug switches or coupling for electric circuits." T. H. Marsh and A. Vandam. Dated August 3rd, 1897. The base or socket of a plug switch or coupling has secured at its centre a tubular insulating piece, and partly surrounding it with a space between is a partial tubular piece. These are preferably formed in one piece. Within the insulating piece is fitted a conducting tube connected to one terminal. In the space between the insulating and tubular pieces is fitted a split ring contact connected to the other terminal. The plug is fitted with a central contact adapted to engage the piece and also a contact engaging the contact. The leading-in wires are lead in through slots in a clamping block secured by the screw cap. 2 claims.

16,119. "Improvements in incandescence electric lampholders." T. H. Marsh and A. Vandam. Dated August 3rd, 1897. Relates to holders for incandescent lamps. The inner part of a metal holder is protected by insulating material which may be part of the insulating base, or may be a detached ring of glass or porcelain held between the base and a shoulder in the holder, or may be a lining applied to the inside of the holder. A curved projection from the base separates the plunger sockets. 2 claims.

16,120. "Improvements in the manufacture and production of electric cables." H. Edmunds. Dated August 3rd, 1897. Metal sheathing, such as lead, or insulated steel strip, is covered with a non-fibrous preservative composition, in order that the cable may be laid underground without further protection. A suitable composition is a mixture of oxidised linseed oil 10 parts, pitch 60 parts, French chalk 40 parts, and sulphur 3 to 8 parts; the pitch may be replaced by oxidised oil, the sulphur omitted, and the French chalk replaced by asbestos, talc, or ground cork. It may be applied by a machine similar to those used for applying lead sheathing. 1 claim.

16,176. "Improvements in or relating to electrical accumulators or storage batteries." A. Heil. Dated August 4th, 1897. The frame for supporting the active material consists of a series of hexagonal cells with flanged edges to retain the active material in the cells. Reference is made to Specification No. 3,986, A.D. 1888. 2 claims.

16,235. "Improvements in connection with arc lamps." W. J. H. Jones, F. J. Chaplin, and S. Jevons. Dated August 5th, 1897. Relates to regulating mechanism for a focussing arc lamp. The carbon holders are carried by the ends of two cords passed over pulleys in stationary bearings, one sets of pulleys supporting the parts of the cords attached to the upper holder is carried by a spindle on anti-friction wheels. Horizontal series and shunt solenoids are placed at the sides of the pulleys and act on cores attached to the ends of a horizontal lever. This is connected by a link to a lever having two arms with V-grooves which engage and lift the spindle from the friction wheels when the action of the series coil preponderates to strike the arc. For feeding the carbons the shunt coil causes the lever to lower the spindle upon the anti-friction wheels so that it can rotate. In a modification the upper carbon is carried by a rack in engagement with a pinion on a spindle which carries two flanged wheels and can rotate in bearings. A series or differentially-wound coil acts through a core and slotted levers on rotatable discs; these carry a pin operating a lever and brake blocks to lift the flanged wheels with the spindle, rack and upper carbon, to strike the arc, when the action of the series coil is sufficient. For feeding the carbon the brake allows the wheels and spindle to rotate in the bearings. The lower carbon may be fixed or connected by cords and pulleys with the upper one. 2 claims.

16,284. "A new or improved method of making high electrical resistances." F. B. Fawcett. Dated August 6th, 1897. A high resistance is made by depositing on clean glass a very thin film of a metallic alloy, attaching connecting wires by soldering, boiling in heavy mineral oil under reduced pressure for some time and cutting the film so that it forms a long zig-zag of the required resistance. The resistance is then placed in a glass vessel, the wires sealed in, and the vessel is filled with oil, heated under reduced pressure to remove volatile matter, and then sealed. It is then heated in boiling water for some days until the resistance is constant. An auxiliary wire or other resistance may be added to adjust the resistance to the required value, and the whole mounted in a case with terminals. The films are deposited by supporting the glass in a high vacuum in metal holders between a platinum and gold wire cathode, and a wire anode, and passing the discharge from an induction coil until the glass is partially opaque. The film is cut by a steel style, under which the glass is traversed. 4 claims.

16,289. "Improvements connected with the ignition of gas lights by means of electric sparks." R. J. Urquhart. Dated August 6th, 1897. Relates to means for lighting gas by electricity. A compact device for directly igniting the main burners of incandescent and other gas burners is formed by separating electrical conductors which respectively carry either sparking wires or the ends of an equivalent incandescent wire, by a sleeve of insulating material. The switch, &c., apparatus may be of any known construction. 1 claim.

16,354. "Improvements in apparatus for measuring and recording electric currents." H. Aron. Dated August 6th, 1897. Relates to energy meters. In a watt-hour meter based on those described in Specifications No. 4,472, A.D. 1881, and No. 3,484, A.D. 1882, an electric winding apparatus drives two independent clockworks. The main clockwork may consist of a wheel driving a pinion and wheel, which in turn drives a pinion and escapement wheel. The escapement wheel drives and is controlled by an anchor; this is geared by a toothed sector and a bevel wheel to a shaft which carries pressure coils parallel to stationary current coils, the rate of oscillation of the said shaft and anchor, and therefore the velocity of the escapement wheel and the wheel driving it, being proportional to the square root of the power supplied. Current is conveyed to the pressure coils by weak springs having no controlling action. The second escapement wheel drives and is controlled by a second anchor and pendulum; its rate is thus uniform, when going, but it is normally stopped by one of two pins on the second escapement wheel engaging a lever. As the main wheel turns, each of several studs on it displaces the said lever and allows the second escapement wheel to make one turn. The connected wheel thus rotates a definite amount also, and projections on it move a lever. This lever carries two wheels which, when moved, connect a wheel of the main clockwork with an adjacent wheel of a counting gear for a fixed time. The number of such connections of the counting gear during any time, and the amount of motion given to it during each connection, being each proportional to the square root of the power, the motion of the counter is directly proportional to the energy supplied during the time. 8 claims.

16,416. "Improvements in or relating to electric traction." S. P. Thompson and M. Walker. Dated August 7th, 1897. Relates to means for preventing of contacts of electric railways and tramways on a road contact system from being left alive after the vehicle has passed. Auxiliary studs are connected to the main surface behind, and are brushed by an auxiliary skate on the vehicle and thereby short-circuited, so as to operate a cut-out and an indicator on the vehicle also, if required. In a modification the auxiliary studs are only connected to the main studs on both sides by a switch when the main switch at the adjacent main contact is operated. 3 claims.

16,430. "Improvements in the manufacture of electric accumulators." F. Pescetto. Dated August 7th, 1897. The grids have the edges of the holes therein struck up into protuberances which hold the active material in place. The lead oxides forming the active material are mixed with an ulmic compound, such as is described in Specification No. 13,092, A.D. 1887, in order to render the active material porous. 2 claims.

16,438. "Improved coil for electric instruments." W. Thomson, Baron Kelvin of Largs. Dated August 7th, 1897. Coils to carry strong currents are constructed in either of two ways, to give more uniform fields and occupy less space than usual. In one form, for very large currents, copper tubes are divided helically from end to end; they are of such sizes as to fit within one another, with intervening insulation or air spaces; alternate tubes are cut right and left handed, and connected at opposite ends. In another form, a modification of a construction described in Specification No. 18,035A, A.D. 1888, a coil is made up of radially-slit copper plates. These are tinned on one side and insulated with thin paper or mica on the other. They are bent somewhat and put together in pairs, half the tinned sides of the two plates being in contact, and each plate passed through the slot of the other. Such pairs are placed on a rod, pressed together by end nuts and heated until the tinned surfaces unite. The coil thus formed has half as many turns as plates, and may be placed on an insulating tube. The plates may be circular, as shown, but are preferably rectangular, to provide more cooling surface. 1 claim.